695127/2022/PS-PEM-EL

OWNER - MAHARASHTRA STATE POWER GENERATION CO. LTD.

CONSULTANT - DEVELOPMENTS CONSULTANT PVT. LTD.

1 X 660 MW BHUSAWAL TPS UNIT-6

VOLUME – II

TECHNICAL SPECIFICATION FOR

OIL FILLED SERVICE TRANSFORMERS

BHEL DOCUMENT NO. : PE-TS-415-302-E001, REV-00

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA – 201301

	TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	SPECIFICATION NO. PE-TS-415-302-E001
		VOLUME II
	1 X 660 MW BHUSAWAL TPS	REVISION 0 / DATE: 5.6.2020
		SHEET 1 OF 1

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COMPLIANCE CERTIFICATE

The bidder shall confirm compliance to the following by signing/ stamping this compliance certificate and furnishing same with the offer.

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same.

2. There are no deviation with respect to specification other than those furnished in the 'schedule of deviations'

3. Only those technical submittals which are specifically asked for in NIT to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of offer.

4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.

5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in 'BOQ-Cum-Price schedule' of the specification shall not be considered (i.e., technical description & quantities as per the specification shall prevail).

BIDDER'S STAMP & SIGNATURE

	TITLE :	SPEC NO. : PE-TS-415-302-E001	
	TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	VOLUME NO : II	
		SECTION : I	
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SECTION 'I'

SPECIFIC TECHNICAL REQUIREMENTS

	TITLE :	SPEC NO. : PE-TS-415-302-E001	
	TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	VOLUME NO : II	
		SECTION : I	
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1.0 SCOPE OF ENQUIRY

1.1 This specification covers the design, manufacture, inspection and testing at manufacturer's works, proper packing and delivery to site of **OIL FILLED SERVICE TRANSFORMERS** as mentioned in different sections of this specification, complete with all accessories for efficient and trouble-free operation.

1.2 It is not the intent to specify herein all the details of design & manufacture. However, the equipment shall conform in all respect to high standards of design engineering and workmanship and shall be capable of performing in continuous commercial operation.

1.3 Standard technical requirements of the oil filled service transformers are indicated in Section-II. Project specific requirements/changes are listed in Section-I.

1.4 <u>The requirements of Section-I shall prevail and govern in case of conflict between the corresponding requirements of Section-I and Section-II.</u>

2.0 BILL OF QUANTITIES:

2.1 Quantity requirements shall be as per BOQ-cum-price schedule as part of NIT

3.0 SPECIFIC TECHNICAL REQUIREMENTS

3.1 Refer Annexure-III attached with Section I for project specific requirements

3.2 Other technical specific requirement

S.No.	***Reference Clause No. of Section- II and Annexure-III***	***Specific Requirement/ Change***
1.	Clause 7.00.00 of Section -II - COMMISSIONING SPARES AND O & M SPARES	This clause stands deleted except scope of special tools and tackles as per BOQ cum price schedule and Annexure-III
2.	Clause 3.13.00 of Section-II, Clause 4.7.2, 4.7.3 of Annexure-III - CABLE BOX	Additional Clause: 10mm Neoprene Gasket shall be provided. Gasket Protection Cover shall be provided in between for the following,

	TITLE : **TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS** **1 X 660 MW BHUSAWAL TPS**	SPEC NO. : PE-TS-415-302-E001	
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		a) HV Cable Box and Disconnecting Chamber b) Disconnecting Chamber Box and Tank body c) Front Inspection Cover for HV Cable Box Phase barriers & Rain Canopy profile shall be provided for HV Cable box. Protruded Type of Inspection Covers shall be used all over the Transformer body Anti-Tracking Paint shall be used inside HV Cable Box/ LV Busduct
3	Clause 3.22.00 of Section-II	This clause shall be read as "For 33KV, 11KV and 6.6 KV type of winding shall be continuous disc and for 3.3 KV and 433/420V type of winding shall be spiral / continuous disc. The conductor shall be electrolytic grade copper

4.0 DOCUMENTATION

4.1 Documents required along with technical offer shall be as per Annexure-I

4.2 Documents required after award of LOI shall be as per Annexure -II

ANNEXURE – I

DOCUMENTS REQUIRED ALONG WITH TECHNICAL OFFER

a) The enclosed Data Sheet-B filled up completely for each rating/ type of transformers
b) Schedule of deviations
c) Schedule of BOQ cum price schedule (Unpriced)
d) Schedule of Mandatory spares (Unpriced)
e) Schedule of Type test (Unpriced)
f) GA drg and foundation plan (including total weight and oil quantity) of each rating of transformer as per BOQ. There shall not be major changes from details furnished in case of award of contract

 For applicable drawing / document and their submission schedule please refer NIT

ANNEXURE -II

DOCUMENTS REQUIRED AFTER AWARD OF LOI

Following documents/drawings shall be submitted after placement of order for BHEL & Customer approval

Sl. No.	BHEL Drawings/ Document Number	Drawings/ Document Description	Drawings/ Document Type
1	PE-V0-415-302-E011	1000 KVA SERVICE TRANSFORMER (11/3.45 KV) OUTLINE GENERAL ARRANGEMENT DRAWING (OGA) AND LIST OF FITTINGS/ACCESSORIES	Primary
2	PE-V0-415-302-E012	1000 KVA, 11/3.45 KV TRANSPORTATION DRG	Secondary
3	PE-V0-415-302-E013	1000 KVA, 11/3.45 KV TWIN BIDIRECTIONAL ROLLER	Primary
4	PE-V0-415-302-E014	1000 KVA TRANSFORMER (11/3.45 KV) HV CABLE BOX & LV BUSDUCT/CABLE TERMINATION ARRANGEMENT DRAWING	Primary
5	PE-V0-415-302-E015	1000 KVA SERVICE TRANSFORMER (11/3.45 KV) BILINGUAL RATING & DIAGRAM PLATE	Primary
6	PE-V0-415-302-E016	1000 KVA TRANSFORMER (11/3.45 KV) GA BUSHING DRG/(H/V, LV & NEUTRAL)	Primary
7	PE-V0-415-302-E017	1000 KVA TRANSFORMER (11/3.45 KV) GENERAL ARRANGEMENT AND WIRING DIAGRAM OF MARSHALLING BOX	Primary
8	PE-V0-415-302-E018	1000 KVA TRANSFORMER (11/3.45 KV) FOUNDATION DRAWING	Secondary
9	PE-V0-415-302-E019	1000 KVA SERVICE TRANSFORMER (11/3.45 KV) TECHNICAL DATA SHEET	Primary
10	PE-V0-415-302-E020	1000 KVA SERVICE TRANSFORMER (11/3.45 KV) VALVE SCHEDULE PLATE	Primary
11	PE-V0-415-302-E021	1000KVA TRANSFORMER (11/3.45 KV) TYPE TEST REPORT	Primary
12	PE-V0-415-302-E111	2000 KVA SERVICE TRANSFORMER (11/3.45 KV) OUTLINE GENERAL ARRANGEMENT DRAWING (OGA) AND LIST OF FITTINGS/ACCESSORIES	Primary
13	PE-V0-415-302-E112	2000 KVA, 11/3.45 KV TRANSPORTATION DRG	Secondary
14	PE-V0-415-302-E113	2000 KVA, 11/3.45 KV TWIN BIDIRECTIONAL ROLLER	Primary
15	PE-V0-415-302-E114	2000 KVA TRANSFORMER (11/3.45 KV) HV CABLE BOX & LV BUSDUCT/CABLE TERMINATION ARRANGEMENT DRAWING	Primary
16	PE-V0-415-302-E115	2000 KVA SERVICE TRANSFORMER (11/3.45 KV) BILINGUAL RATING & DIAGRAM PLATE	Primary
17	PE-V0-415-302-E116	2000 KVA TRANSFORMER (11/3.45 KV) GA BUSHING DRG/(H/V, LV & NEUTRAL)	Primary
18	PE-V0-415-302-E117	2000 KVA TRANSFORMER (11/3.45 KV) GENERAL ARRANGEMENT AND WIRING DIAGRAM OF MARSHALLING BOX	Primary
19	PE-V0-415-302-E118	2000 KVA TRANSFORMER (11/3.45 KV) FOUNDATION DRAWING	Secondary
20	PE-V0-415-302-E119	2000 KVA SERVICE TRANSFORMER (11/3.45 KV) TECHNICAL DATA SHEET	Primary
21	PE-V0-415-302-E120	2000 KVA SERVICE TRANSFORMER (11/3.45 KV) VALVE SCHEDULE PLATE	Primary
22	PE-V0-415-302-E121	2000 KVA TRANSFORMER (11/3.45 KV) TYPE TEST REPORT	Primary
23	PE-V0-415-302-E211	6300 KVA SERVICE TRANSFORMER (11/3.45 KV) OUTLINE GENERAL ARRANGEMENT DRAWING (OGA) AND LIST OF FITTINGS/ACCESSORIES	Primary
24	PE-V0-415-302-E212	6300 KVA, 11/3.45 KV TRANSPORTATION DRG	Secondary
25	PE-V0-415-302-E213	6300 KVA, 11/3.45 KV TWIN BIDIRECTIONAL ROLLER	Primary
26	PE-V0-415-302-E214	6300 KVA TRANSFORMER (11/3.45 KV) HV CABLE BOX & LV BUSDUCT/CABLE TERMINATION ARRANGEMENT DRAWING	Primary
27	PE-V0-415-302-E215	6300 KVA SERVICE TRANSFORMER (11/3.45 KV) BILINGUAL RATING & DIAGRAM PLATE	Primary
28	PE-V0-415-302-E216	6300 KVA TRANSFORMER (11/3.45 KV) GA BUSHING DRG/(H/V, LV & NEUTRAL)	Primary
29	PE-V0-415-302-E217	6300 KVA TRANSFORMER (11/3.45 KV) GENERAL ARRANGEMENT AND WIRING DIAGRAM OF MARSHALLING BOX	Primary
30	PE-V0-415-302-E218	6300 KVA TRANSFORMER (11/3.45 KV) FOUNDATION DRAWING	Secondary
31	PE-V0-415-302-E219	6300 KVA SERVICE TRANSFORMER (11/3.45 KV) TECHNICAL DATA SHEET	Primary
32	PE-V0-415-302-E220	6300 KVA SERVICE TRANSFORMER (11/3.45 KV) VALVE SCHEDULE PLATE	Primary
33	PE-V0-415-302-E221	6300 KVA TRANSFORMER (11/3.45 KV) TYPE TEST REPORT	Primary
34	PE-V0-415-302-E311	7500 KVA SERVICE TRANSFORMER (11/3.45 KV) OUTLINE GENERAL ARRANGEMENT DRAWING (OGA) AND LIST OF FITTINGS/ACCESSORIES	Primary
35	PE-V0-415-302-E312	7500 KVA, 11/3.45 KV TRANSPORTATION DRG	Secondary

36	PE-V0-415-302-E313	7500 KVA, 11/3.45 KV TWIN BIDIRECTIONAL ROLLER	Primary
37	PE-V0-415-302-E314	7500 KVA TRANSFORMER (11/3.45 KV) HV CABLE BOX & LV BUSDUCT/CABLE TERMINATION ARRANGEMENT DRAWING	Primary
38	PE-V0-415-302-E315	7500 KVA SERVICE TRANSFORMER (11/3.45 KV) BILINGUAL RATING & DIAGRAM PLATE	Primary
39	PE-V0-415-302-E316	7500 KVA TRANSFORMER (11/3.45 KV) GA BUSHING DRG/(H/V, LV & NEUTRAL)	Primary
40	PE-V0-415-302-E317	7500 KVA TRANSFORMER (11/3.45 KV) GENERAL ARRANGEMENT AND WIRING DIAGRAM OF MARSHALLING BOX	Primary
41	PE-V0-415-302-E318	7500 KVA TRANSFORMER (11/3.45 KV) FOUNDATION DRAWING	Secondary
42	PE-V0-415-302-E319	7500 KVA SERVICE TRANSFORMER (11/3.45 KV) TECHNICAL DATA SHEET	Primary
43	PE-V0-415-302-E320	7500 KVA SERVICE TRANSFORMER (11/3.45 KV) VALVE SCHEDULE PLATE	Primary
44	PE-V0-415-302-E321	7500 KVA TRANSFORMER (11/3.45 KV) TYPE TEST REPORT	Primary
45	PE-V0-415-302-E411	10000 KVA SERVICE TRANSFORMER (11/3.45 KV) OUTLINE GENERAL ARRANGEMENT DRAWING (OGA) AND LIST OF FITTINGS/ACCESSORIES	Primary
46	PE-V0-415-302-E412	10000 KVA, 11/3.45 KV TRANSPORTATION DRG	Secondary
47	PE-V0-415-302-E413	10000 KVA, 11/3.45 KV TWIN BIDIRECTIONAL ROLLER	Primary
48	PE-V0-415-302-E414	10000 KVA TRANSFORMER (11/3.45 KV) HV CABLE BOX & LV BUSDUCT/CABLE TERMINATION ARRANGEMENT DRAWING	Primary
49	PE-V0-415-302-E415	10000 KVA SERVICE TRANSFORMER (11/3.45 KV) BILINGUAL RATING & DIAGRAM PLATE	Primary
50	PE-V0-415-302-E416	10000 KVA TRANSFORMER (11/3.45 KV) GA BUSHING DRG/(H/V, LV & NEUTRAL)	Primary
51	PE-V0-415-302-E417	10000 KVA TRANSFORMER (11/3.45 KV) GENERAL ARRANGEMENT AND WIRING DIAGRAM OF MARSHALLING BOX	Primary
52	PE-V0-415-302-E418	10000 KVA TRANSFORMER (11/3.45 KV) FOUNDATION DRAWING	Secondary
53	PE-V0-415-302-E419	10000 KVA SERVICE TRANSFORMER (11/3.45 KV) TECHNICAL DATA SHEET	Primary
54	PE-V0-415-302-E420	10000 KVA SERVICE TRANSFORMER (11/3.45 KV) VALVE SCHEDULE PLATE	Primary
55	PE-V0-415-302-E421	10000 KVA TRANSFORMER (11/3.45 KV) TYPE TEST REPORT	Primary
56	PE-V0-415-302-E422	10000 KVA TRANSFORMER (11/3.45 KV) DESIGN CALCULATIONS FOR SHORT CIRCUIT CAPABILITY	Secondary
57	PE-V0-415-302-E511	630 KVA SERVICE TRANSFORMER (6.6/0.433 KV) OUTLINE GENERAL ARRANGEMENT DRAWING (OGA) AND LIST OF FITTINGS/ACCESSORIES	Primary
58	PE-V0-415-302-E512	630 KVA, 6.6/0.433 KV TRANSPORTATION DRG	Secondary
59	PE-V0-415-302-E513	630 KVA, 6.6/0.433 KV TWIN BIDIRECTIONAL ROLLER	Primary
60	PE-V0-415-302-E514	630 KVA TRANSFORMER (6.6/0.433 KV) HV CABLE BOX & LV BUSDUCT/CABLE TERMINATION ARRANGEMENT DRAWING	Primary
61	PE-V0-415-302-E515	630 KVA SERVICE TRANSFORMER (6.6/0.433 KV) BILINGUAL RATING & DIAGRAM PLATE	Primary
62	PE-V0-415-302-E516	630 KVA TRANSFORMER (6.6/0.433 KV) GA BUSHING DRG/(H/V, LV & NEUTRAL)	Primary
63	PE-V0-415-302-E517	630 KVA TRANSFORMER (6.6/0.433 KV) GENERAL ARRANGEMENT AND WIRING DIAGRAM OF MARSHALLING BOX	Primary
64	PE-V0-415-302-E518	630 KVA TRANSFORMER (6.6/0.433 KV) FOUNDATION DRAWING	Secondary
65	PE-V0-415-302-E519	630 KVA SERVICE TRANSFORMER (6.6/0.433 KV) TECHNICAL DATA SHEET	Primary
66	PE-V0-415-302-E520	630 KVA SERVICE TRANSFORMER (6.6/0.433 KV) VALVE SCHEDULE PLATE	Primary
67	PE-V0-415-302-E521	630 KVA TRANSFORMER (6.6/0.433 KV) TYPE TEST REPORT	Primary
68	PE-V0-415-302-E901	MQP FOR OIL FILLED SERVICE TRANSFORMERS	Primary
69	PE-V0-415-302-E902	O&M MANUAL/FQP FOR OIL FILLED SERVICE TRANSFORMERS	Secondary
70	PE-V0-415-302-E903	BOM (BILL OF MATERIAL) FOR OIL FILLED TRANSFORMERS	Secondary

Note:

1. Drawing/ document nos. provided are tentative & may change, there shall be no commercial/ delivery implication to BHEL on this account
2. Vendor shall submit a chart mentioning the dates for drawing/document submission/BHEL comments/resubmission after approval of documents
3. In BOM each of the item to be uniquely identified with item code no. or item Sl. no. Supplier to ensure that all the items which will find separate mention in the packing list are covered in detailed BOM.Supplier to give following undertaking in BOM: " The BOM provided here completes the scope (in content and intent) of material supply under PO no. ---- dtd ----- Any additional material which may become necessary for the intended application of supplied item/package will be supplied free of cost in most reasonable time."

ANNEXURE - III

PROJECT SPECIFIC REQUIREMENT

1.0 SCOPE OF SUPPLY

1.3 Each transformer shall be furnished complete with

(a) Fittings and accessories

(b) Auxiliary equipment

(c) First filling of oil including 10% extra (Part of BOQ cum price schedule)

1.4 One set of special tools and tackles (Part of BOQ cum price schedule)

1.5 Mandatory Spare parts (Part of BOQ cum price schedule)

1.7 All relevant drawings, data and instruction manuals.

2.0 CODES AND STANDARDS

2.1 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC except where modified and/or supplemented by this specification.

2.2 Equipment and material conforming to any other standard which ensures equal or better quality may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

2.3 The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

3.0 DESIGN CRITERIA

3.1 The transformer will be used to supply power for units & auxiliaries. The high voltage winding will be connected to the HV switchgear. The low voltage winding feeds the 3.3kV switchgear.

3.2 The transformer will be installed in hot, humid and tropical atmosphere. All equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.

3.3 The transformer shall be capable of continuous operation at rated output under the following condition :

(a)	Voltage variation	:	± 10%
(b)	Frequency variation	:	± 5%

(c) Combined voltage and frequency : 10% variation (absolute sum)

3.4 The transformer shall be so designed that it is capable of operation at 125% rated voltage for a period of one minute and 140% rated voltage for a period of five seconds due to sudden load throw off.

3.5 The transformer shall be capable of withstanding the short circuit stresses due to a terminal fault on one winding with full voltage maintained on the other winding for minimum period of two (2) seconds.

3.6 The transformer shall be free from annoying hum or vibration. The design shall be such as not to cause any undesirable interference with radio or communication circuits.

3.7 The noise level shall be limited to the value specified by NEMA Standard Publication No. TR-1-1993 when measured in accordance with conditions outlines in ANSI/IEEE C57.12.90-1999/IS13964/CBIP publication.

4.0 SPECIFIC REQUIREMENTS

4.1 TANKS

4.1.1 The tank shall be fabricated from good commercial grade low carbon steel of adequate thickness.

4.1.2 The tank wall shall be reinforced by stiffener to ensure rigidity so that it can withstand without any deformation

(a) Mechanical shock during transportation,

(b) Oil filling by vacuum,

(c) Short circuit forces and

(d) Continuous internal pressure of 35 kN/m² over normal hydrostatic pressure of oil.

4.1.3	All removable covers shall be provided with weatherproof, hot oil resistant, resilient gaskets. The design shall be such as to prevent any ingress of water into or oil from the tank.
4.1.4	The tank shall be provided with one set of bi-directional flanged wheels for rolling the transformer parallel to either canter line over 1676 mm rail gauge. In case more than two rails are required to be provided the rail gauge of 1676 mm shall be maintained between two adjacent rails.
4.1.5	Jacking pads, lifting eyes and pulling lugs shall be provided to facilitate movement of the transformer. All heavy removal parts shall be provided with eye bolt for ease of handling.
4.1.6	Manholes/hand-holes of sufficient size shall be provided for access to leads, windings, bottom terminals of bushings and taps.
4.1.7	Suitable guide shall be provided in the tank for positioning the core and coil assembly.
4.2	CORE & COILS
4.2.1	The core shall be built up with high grade, non-aging, low loss, high permeability, grain oriented, cold-rolled silicon steel laminations especially suitable for core material.
4.2.2	The coils shall be manufactured from electrolytic copper conductor and fully insulated for rated voltage. Insulation shall be of Class A.
4.2.3	Insulating material shall be of proven design. Coils shall be so insulated that impulse and power frequency voltage stresses are minimum.
4.2.4	Coil assembly shall be suitably supported between adjacent sections by insulating spacers and barriers. Bracing and other insulation used in assembly of the winding shall be arranged to ensure a free circulation of the oil and to reduce the hot spot of the winding.
4.2.5	All leads from the windings to the terminal board and bushings shall be rigidly supported to prevent injury from vibration or short circuit stresses. Guide tube shall be used where practicable.

4.2.6 The core and coil assembly shall be securely fixed in position so that no shifting or deformation occurs during movement of transformer or under short circuit stresses.

4.3 TAPPING

4.3.1 Off-circuit tap change (OCTC) as specified in the Datasheet-A shall be provided
on the high voltage winding.

4.3.2 The transformer shall be capable of operation at its rated kVA on any tap provided the voltage does not vary by more than ±10% of the rated voltage corresponding to the tap.

4.3.3 The winding including the tapping arrangement shall be designed to maintain electromagnetic balance between HV and LV windings at all voltage ratios.

4.4 OFF-CIRCUIT TAP CHANGER (OCTC)

4.4.1 The off-circuit tap changing will be affected by a gang operated switch for three-phase unit. Arrangement shall such that switch can be operated at standing height from ground level.

The operating handle can be padlocked at any tap position. The design shall be such that the lock cannot be inserted unless the contacts are correctly engaged.

4.4.2 The mechanism shall be provided with a mechanical tap position indicator and an operation counter.

4.4.3 All contacts shall be silver plated and held in position under strong contact pressure to ensure low contact drop and avoid pitting.

4.5 INSULATING OIL

4.5.1 The transformer shall be filled with mineral insulating oil suitably inhibited to prevent sludging.

4.5.2 First filling of oil along with 10% excess shall be furnished for each transformer. Oil shall be supplied in non-returnable Drum suitable for outdoor storage.

4.5.3 Oil preservation shall be by means of bellows/ diaphragm sealed conservator tank with silica gel breather to avoid direct connection between atmosphere and transformer oil. It shall be complete with level gauges, pipes, drain valve, bucholz relay with shut-off valves at both sides etc. The level gauges shall be so placed that same can be readable standing from ground. Necessary device shall be kept to provide annunciation in the event of rupturing of bellow.

4.6 BUSHING

4.6.1 Bushing rated below 52kV voltage class shall be solid porcelain or oil communicating type.

4.6.2 Bushings shall be provided with terminal connectors of approved type and size.

4.6.3 Bushing location shall provide adequate phase and ground clearances.

4.7 TERMINAL ARRANGEMENTS

4.7.1 The physical position of the terminals and the markings shall be as per relevant IS/IEC unless otherwise shown in the enclosed drawing. Low voltage terminals shall be brought out through top cover mounted bushings with matching flanges around each bushing for connection to Segregated phase bus. The contractor shall furnish all necessary details in this connection for co-ordination with the busduct and shall guarantee the matching dimensions within close tolerance.

4.7.2 High voltage terminals shall be brought out thru' side wall mounted bushings, for cable connection. A detachable type cable end-box with disconnect links shall be furnished.

4.7.3 Low voltage winding neutral shall be brought out thru' side wall mounted bushing to a detachable cable end-box with disconnect link.

4.7.4 The cable end-box shall be self-supporting, weather-proof, air filled type, complete with all hardware such as gland plate, brass glands, tinned copper lugs, armour clamps etc.

4.7.5 In general, the arrangement shall be such as to permit removal of transformer and core/coil assembly without dismantling the bus duct/cable connection

4.8 COOLING SYSTEM

4.8.1 The transformer cooling system (ONAN~~/ONAF~~) and number of cooling banks and capacity of each bank shall be as specified in the Datasheet-A. The cooling system shall comprise number of cooling units each complete with its radiator banks~~, pumps, fans~~ and other accessories.

4.8.2 Transformer fitted with multiple cooling units but without having stand-by cooling units, it shall be able to deliver its rated output not exceeding specified temperature rise and calculated hot-spot temperature of 150°C under following conditions:

(a) for 20 minutes after failure of the blowers of one unit

(b) for 10 minutes in the event of failure of the cooler units

4.8.3 The radiators shall be detachable type with top and bottom isolation valves to permit the removal of the same without drainage of oil from the tank.

~~4.8.4 All fans shall have safety guard. Pumps shall be provided with flow indicators for visual indication of oil flow.~~

~~4.8.5 Convenient means shall be provided to remove or replace any pump or fan with the transformer in service~~

~~4.8.6 Complete control for fans inclusive of all switches, fuses, starters, relays and wiring shall be furnished. Each motor circuit shall have over load and short- circuit protection.~~

~~4.8.7 Fan motor controls will be actuated automatically from winding temperature indicator contacts. Provision shall however be kept for manual~~

~~operation from local cooler control panel and remote from central control room by serial link communication with the plant PLC/DCS.~~

4.9 COOLER CONTROL PANEL (NOT APPLICABLE)

4.9.1 The transformer cooler control panel shall be used for control, interlocking, metering and indication of cooler control system of transformer and shall be installed outdoor near the transformer coolers.

4.9.2 Control panels shall be of CRCA sheet steel construction with protection class of IP-52 for indoor and IP-55 for outdoor installation.

4.9.3 The frames and load bearing panels shall be fabricated of not less than 2 mm thick sheet steel. The doors and covers shall not be less than 1.6mm thick.

4.9.4 All access doors shall be provided with channel rubber/ neoprene gaskets all round.

4.9.5 The operating height shall be limited from 750 mm to 1800 mm. The total height of the panel and its depth shall be matched with adjacent panel.

4.9.6 The operating handle shall have locking arrangement. The panels shall be complete with floor channel sills, vibration damping pads and stainless steel kick plates.

4.9.7 All instrument, relays, switches, etc. mounted on the front face of the panel shall be flush or semi flush type. Switch contacts shall be silver faced and rated at least 10 Amp at operating voltage. Push buttons shall have required number of contacts.

4.9.8 Panel shall be provided with internal illumination lamp with door switch, space heater with thermostat one 5A, 3 pin receptacles with plug.

4.9.9 The annunciation system shall be solid-state type with optical isolation for input signals. It shall be complete with its own power supply, audible alarms, acknowledge, reset, and test buttons and other necessary accessories.

4.9.10 The control panels shall be fully wired up at factory. All spare contacts of relays and switches shall be wires upto the terminal blocks.

4.9.11 The panel shall have provision of cable entry from bottom. Bottom gland plate shall be 3mm thick.

4.9.12 50 x 6 mm GS Flat ground bus shall be provided on the panel extending along the entire length of the assembly. The ground bus shall have two-bolt drilling with GS bolts and nuts at each end to receive plant grid's ground connection.

4.10 MARSHALLING BOX

4.10.1 A sheet steel, weatherproof, IPW55, marshalling box shall be provided for the transformer. The box shall contain all auxiliary devices except those which must be located directly on the transformer.

4.10.2 All terminal blocks required for cable connection shall be located in this box.

4.10.3 The marshalling box shall be provided with cubicle lamp with door switch, space heater with thermostat and removable cable gland plate.

4.11 WIRING

4.11.1 All control, alarm and indication devices provided with the transformer shall be wired upto the terminal blocks.

4.11.2 Wiring shall be done with flexible, 650V grade PVC wires in conduit or PVC armored cable. Minimum wire size shall be 2.5 mm^2 copper. Not more than two wires shall be connected to a terminal. 10% spare terminals shall be provided.

4.11.3 Multi-way terminal block complete with mounting channel, binding screws and washers for wire connections and marking strip for circuit identification shall be provided for terminating the panel wiring. Terminals shall be stud type, suitable for terminating 2 nos. 2.5 mm^2 stranded copper conductor and provided with acrylic insulating cover.

Terminals for C.T. secondary leads shall have provision for shorting and grounding.

4.11.4 All devices and terminal blocks shall be identified by symbols corresponding to those used in applicable schematic or wiring diagram. Each wire shall be identified, at both ends, with interlocking type permanent markers bearing wire numbers as per Contractor's Wiring Diagrams. AC / DC wiring shall have separate color-coding.

4.11.5 Wire termination shall be made with crimping type connectors with insulating sleeves. Wires shall not be spliced between terminals.

4.12 GROUNDING

4.12.1 The grounding pads, located on the opposite sides of the tank, shall be provided for connection to station ground mat.

4.12.2 Grounding pad shall have clean buffed surface with two tapped holes, M10 GS bolts and spring washers for connection to 75x10 mm GS flat.

4.12.3 Ground terminals shall be also provided on marshalling box to ensure its effective earthing.

4.12.4 For continuity of earth connection, all gasketted joints shall be provided with braided copper wire jumpers.

4.13 AUXILIARY SUPPLY

4.13.1 A.C. supply will be made available to each transformer by two separate feeders one normal and the other standby.

4.13.2 Isolating switch fuse unit shall be provided for each of the incoming supply along with automatic changeover scheme to switch on to the standby source in case of failure of the normal supply.

4.14 AUXILIARY EQUIPMENT

4.14.1 Neutral bushing current transformers shall be furnished as specified.

4.14.2 The arrangement shall be such that the C.T. can be removed from the transformer without removing the tank cover.

4.14.3 CT secondary leads shall be wired upto the terminal blocks.

4.15 PAINTING

4.15.1 All steel surfaces shall be thoroughly cleaned by sand blasting or chemical agents as required, to produce a smooth surface free of scales, grease and rust.

4.15.2 The internal surfaces in contact with insulating oil shall be painted with heat resistant insulating varnish which shall not react with and be soluble in the insulating liquid used.

4.15.3 The external surfaces, after cleaning, shall be given a coat of high quality red oxide or yellow chromate primer followed by filler coats.

4.15.4 The transformer shall be finished with two coats of RAL 7032 paint unless otherwise specified.

4.15.5 The paints shall be carefully selected to withstand tropical heat, rain etc. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling.

4.15.6 Sufficient quantity of touch up paint shall be furnished for application after installation at site.

4.15.7 If it is considered necessary, the transformer may be given a further coating at site by the Owner/Purchaser. The Bidder shall therefore indicate the type and quality of the paint with full specification for this purpose.

4.15.8 All supporting structures and hardware shall be hot dip galvanized.

4.16 TRANSPORTATION

4.16.1 Transformer tank shall be dispatched filled with oil or pure dry inert Nitrogen gas depending upon the transport weight limitations. A positive pressure of 2 to 2.5 Psi at temperature of 36 Deg C approximate shall be

kept. In case the tank is filled with oil, sufficient space is left above the oil to take care of the expansion of the oil. The space is filled with pure dry air or inert gas under atmospheric pressure.

The temperature and pressure at the time of gas filling shall be marked on a tag. A graph showing pressure vs. temperature shall be attached for reading pressures at different temperatures. Necessary valves, two stage pressure regulators, filled up Nitrogen cylinder etc. along with other accessories required shall be provided with the tank for intermittent replenishment during transportation.

4.16.2 Impact Recorder

Impact recorder/indicator shall be provided to monitor the impact experienced by the transformer during transport & it shall be returnable.

5.0 TESTS

5.1 ROUTINE TESTS

During manufacture and on completion, all transformers shall be subjected to the routine tests in accordance with latest IEC 60076 and its different parts.

In addition, the following tests shall be performed on each transformer:

5.1.1 Transformer tank with coolers shall be tested for leaks with normal head of oil plus 35 KN/m² for a period of 8 hours. If any leak occurs, the test shall be conducted again after all leaks have been repaired.

5.1.2 During fabrication stage, the tank shall be pressure tested with air at a pressure corresponding to twice the normal head of oil or normal pressure plus 35KN/m² whichever is lower for a period of one hour. Also the tank designed for full vacuum shall be tested for maximum internal pressure of 3.33KN/m² for one hour. The permanent deflection of flat plates shall not exceed CBIP specified figures on release of excess pressure of pressure test and on release of vacuum.

5.1.3	After assembly, each core shall be pressure tested for one minute at 2kV (r.m.s.) A.C. between all bolts, side plates, structural steel works and the core.
5.1.4	The wiring for auxiliary power and control circuitry shall be subjected to withstand one minute power frequency test with 2kV (r.m.s.) to earth
5.1.5	Determination of capacitances windings-to-earth and between windings
5.1.6	Frequency Response Analysis test (This test shall also be undertaken by the manufacturer at site after transformer is installed.)
~~5.1.7~~	~~Measurement of acoustic sound level~~
~~5.1.8~~	~~Measurement of power consumption of fans~~
5.1.9	Measurement of zero sequence impedance(s) on three-phase unit
5.1.10	Measurement of dissipation factor (tan delta) of insulation system capacitances
5.1.11	All test on transformer oil as per IS 335 shall be conducted.
5.1.12	Measurement of winding resistance
5.1.13	Measurement of voltage ratio, and check of voltage vector-relationship
5.1.14	Measurement of impedance voltage/short-circuit impedance
5.1.15	Measurement of No-load loss, and current
5.1.16	Measurement of insulation resistance
5.1.17	Verification of subtractive polarity.
5.2	TYPE TESTS

Following type tests shall be performed on one number 10MVA 11/3.45 kV transformer in accordance with relevant standard

For other rating transformer Type test certificates on transformers of similar type and design for all type tests specified in technical specification shall be furnished for Customer approval. Type test certificate carried out for on identical transformer within last 5 years (as on 6-08-2018) will be accepted

These test reports should be for the tests conducted on equipment similar to those proposed to be supplied under this contract and tests should have been either conducted at an independent laboratory or should have been witnessed by a client. However if contractor is not able to submit type test report of type tests listed in specification or in case of type test reports are not found to be meeting specification requirement, contractor shall conduct all type tests at no additional cost to BHEL either at third party lab or in presence of Customer/ BHEL representative and submit test reports for approval

Following type tests shall be performed on one number 10MVA 11/3.45 kV transformer in accordance with relevant standard:

(a) Dielectric type test (IEC60076-3) & Special Test.

Dielectric test as per method 2 of IS 2026 part III

Separate source voltage withstand test for 1 min.HV- 28kV rms, LV- 10kV rms

Full wave lightning impulse test on HV terminal at 75 kVp

Full wave lightning impulse test on LV terminal at 40kVp

Switching impulse test on HV terminal at rated 75kVp

Repeat no load loss and excitation current measurement after dielectric test at 100% rated voltage and rated frequency.

Determination of transient voltage transfer characteristic.

Measurement of transferred surge on LV winding due to HV lightning impulse.

(b) Measurement of zero-sequence impedance of three-phase transformers

(c) Short circuit test (Refer BOQ cum price schedule Notes for short circuit test)

(d) Measurement of acoustic noise-level

(e) Measurement of the harmonics in the No-load current

(f) Measurement of power consumed by the fans. (If applicable as per Bidder specific design)

(g) Vacuum withstand test (full vacuum)

5.3 MISCELLANEOUS

All component parts and auxiliary equipment such as oil, bushings,

C.Ts etc. shall be routine tested as per relevant Indian Standards.

5.4 TEST WITNESS

Test shall be performed in presence of Owner/Purchaser's representative so desired by the Owner/Purchaser. The Contractor shall give at lest fifteen (15) days advance notice of the date when the tests are to be carried out.

5.5 TEST CERTIFICATES

5.5.1 Certified reports of all the tests carried out at the works shall be furnished in six (6) copies for approval of the Owner/Purchaser.

5.5.2 The equipment shall be dispatched from works only after receipt of Owner/ Purchaser's written approval of the test reports.

5.5.3 Type test certificates on any equipment, if so desired by the. Owner / Purchaser, shall be furnished. Otherwise the equipment shall have to be type tested, free of charge, to prove the design.

6.0 SPECIAL TOOLS & TACKLES

6.1 A set of special tools & tackle which are necessary or convenient for erection, commissioning, maintenance and overhauling of the equipment shall be supplied.

7.0 FITTINGS & ACCESSORIES

Transformer shall be equipped with fittings and accessories as listed below:

7.1 Oil conservator with filler cap, drain plug, plain oil level gauge and alarm contacts for rupturing of bellows/diaphragm.

7.2 Oil preservation system complete with accessories.

7.3 Air release plugs.

7.4 Pressure release device with trip contacts. Explosion vent, if provided, should be double diaphragm type.

7.5	150 mm dial magnetic oil level gauge with low level alarm contacts
7.6	150 mm dial oil temperature indicator with maximum reading pointer and electrically separate contacts for trip and alarm and embedded temperature detectors (PT-100) with suitable output for remote indication (data logging).
7.7	150 mm dial winding temperature indicator with maximum reading pointer and electrically separate sets of contacts for trip, alarm and cooler control and embedded temperature detectors (PT-100) with suitable output for remote indication (data logging).
7.8	Remote winding temperature indicator for mounting on panel with a separate detector element.
7.9	Thermometer pockets.
7.10	Double float Buchholz relay with gas release cock, shut-off valve on either sides with separate sets of contacts for trip and alarm.
7.11	Filter valve with threaded adopter (top and bottom).
7.12	Drain valve with threaded adopter.
7.13	Sampling valve.
7.14	Necessary valves for detachable cooler units.
7.15	Jacking pads, handling and lifting lugs.
7.16	Cover lifting eyes.
7.17	Bi-directional flanged wheels and skids.
7.18	Clamping device with bolts & nuts.
7.19	Hand-hole of sufficient size for access to interior of the tank.
7.20	Two-grounding pads.

7.21 Ladder with safety device for access to the top of transformer tank.

7.22 Weather proof marshalling box for housing control equipment and terminal connections.

7.23 H.V. and L.V. bushing terminal connectors.

7.24 Rating and terminal marking plates.

7.25 Cooler units complete with valves~~, fans,~~ supporting structure with fixing and foundation bolts etc as required ~~and Cooler Control panel.~~

7.26 Tap-changing gear complete with tap position indicator, operation counter etc.

Note:

All indication, alarm, trip contacts provided shall be rated for 0.5A at 220 V D.C. and 5A at 240 V A.C.

8.0 AUXILIARY EQUIPMENT

Transformer shall be provided with LV and Neutral bushing current transformers as specified as indicated below:

		L.V Phase CT	L.V. Neutral CT	
(a)	Application	CT-1	CTN-1	CTN-1
		Restricted	Restricted	Stand by
(b)		Earth Fault	Earth Fault	Earth Fault
(c)	Quantity	3	1	1
(d)	Current Ratio	As required	As required	As required
(e)	Class	PS	PS	5P20

		L.V Phase CT	L.V. Neutral CT	
(f)	Burden VA	-	-	30
(g)	Rated frequency	50	50	50
(h)	Voltage class kV	3.6	3.6	3.6

CT particulars shall be given to Successful bidder during detail engineering. There shall be no commercial implication to BHEL on this account

9.0 For 630 kVA, 6.6/0.433kV Transformer shall be as per IS:2026/ IS:1180, but losses(as defined in datasheet-A & B) shall be as per IS:1180 Further, applicable technical details/spec, accessories and applicable routine test as defined in Sec-I(Ann-III) for 11/3.45kV Transformer shall be considered for the same

10.0 TEST REQUIREMENT FOR 630 KVA 6.6/0.433 kV TRANSFORMER
During manufacturing and on completion, all transformers shall be subjected to the routine tests in accordance with latest IS / IEC and its different parts
The type test certificates shall be submitted (Type test certificate carried out for on identical transformer within last 5 years (as on :6-08-2018) will be accepted)
Type test certificates on transformers of similar type and design for all type tests specified in technical specification shall be furnished for Customer approval. These test reports should be for the tests conducted on equipment similar to those proposed to be supplied under this contract and tests should have been either conducted at an independent laboratory or should have been witnessed by a client. However if contractor is not able to submit type test report of type tests listed in specification or in case of type test reports are not found to be meeting specification requirement, contractor shall conduct all such tests at no additional cost to BHEL either at third party lab or in presence of Customer/ BHEL representative and submit test reports for approval

AUXILIARY POWER TRANSFORMER

SR. NO.	ITEM	UNITS	
1.0	Application		Auxiliary Transformer
2.0	Service		Outdoor, step down
3.0	Type		Oil immersed
4.0	Reference standard		IS 2026 & IEC60076
5.0	Rated power	MVA (Min.)	As per BOQ cum price schedule
6.0	Rated voltage ratio (line to line)	kV	11 /3.45kV
7.0	Number of phases of each unit (1-Ph or 3-PH unit)		3
8.0	No. of phases		3
9.0	Rated frequency	Hz	50
10.0	**COOLING SYSTEM**		
10.1	Type of Cooling & respective power Value % of rated power (ONAN/ONAF)		ONAN ~~/ ONAF~~
10.2	Nos. of cooling units & each capacity		2 X 50%
11.0	**TEMPERATURE RISE**		
11.1	Design ambient temperature	°C	50°C

SR. NO.	ITEM	UNITS	
11.2	Temperature rise above design ambient temperature		
(a)	in oil by thermometer	°C	40°C
(b)	in winding by resistance	°C	45°C
12.0	Insulation level (LI : Lightning Impulse Voltage, AC : Short duration induced & separate source AC withstand Voltage)		
(a)	HV- (LI/AC)		75 kVp/ 28kVrms
(b)	LV-(LI/AC)		40 kVp/ 10kVrms
(c)	LV Neutral – (LI/AC)		40 kVp/ 10kVrms
13.0	Vector group		As per DATA SHEET-A
14.0	Short-circuit impedance at 75°C at principal tap		As per DATA SHEET-A
15.0	Parallel operation of transformer		Yes, Momentary
16.0	**TYPE OF TAPS PROVIDED**		Off Circuit Tap Changer, full capacity
16.1	Taps provided on		H.V. winding

SR. NO.	ITEM	UNITS			
16.2	Range of taps		± 5% @ 2.5		
16.3	METHOD OF TAP CHARGE CONTROL				
(a)	Manual local		Yes		
(b)	Electrical local		No		
(c)	Electrical Remote		No		
(d)	Automatic		No		
17.0	Type of tank construction (bell type or conventional tank with cover)		Convention tank with cover		
18.0	Type of Oil preservation system		Bellows / diaphragm sealed conservator with silica gel.		
19.0	**SYSTEM EARTHING**				
19.1	H.V. (11kV)		Unearthed		
19.2	L.V. (3.3kV)		Non-effectively Earthed		
20.0	**TERMINAL ARRANGEMENT**				
20.1	H.V. (11kV)		11kV XLPE Cable		
20.2	L.V. (3.3kV)		Segregated Phase Busduct		
(a)	LV- Neutral (3.3kV)		As per DATA SHEET-A		
21.0	**TRANSFORMER BUSHING**		HV	LV	LV-N
21.1	Voltage class kV(r.m.s.)		17.5	7.2	7.2

SR. NO.	ITEM	UNITS	
21.2	Material		Solid Porcelain or Oil Communicating Type
21.3	a. Creepage distance mm b. Protective creepage distance	mm/kV mm/kV	31mm / kV Bidder to specify
22.0	**SYSTEM FAULT LEVEL**		
22.1	HV Side (11kV)		44 kA (r.m.s.) for 3sec
22.2	LV Side (3.3kV)		40 kA (r.m.s.) for 3sec
23.0	Max. Flux density in any part of core & Yoke at 110% rated voltage		1.9 Tesla
24.0	Max. Noise level in accordance with Conditions specified in NEMA Std. TR-1		As per NEMA Std. TR-1
25.0	Auxiliary supply		415V± 10%, 3 ph. 50 Hz ± 3% 220V +10%, -15% 2 wire

Domestic Packing for Oil Filled Transformers Rating

A. Transformer shall be despatched in open in such a manner there shall be no damage during transit.

B. Transformer Radiator Assembly, Conservator, Spares and Accessories shall be despatched in "Crate Packing" using wood.

C. Transformer Oil (Extra Oil + Spare Oil) shall be despatched in Non Returnable Sealed Drums with proper marking of Volume and Vendor details.

D. Paint for touchup shall be despatched in "Crate Packing" using wood.

E. CRATE PACKING DETAILS

1.0 PREPARATION OF PACKING CASES:

1.1 DIMENSIONS

1.1.1 Minimum number of planks shall be used for a shook.

1.1.2 Thickness of planks for Front, rear, top and bottom sides and binding, jointing battens shall be 25/20mm +2/-3 mm

1.1.3 Horizontal, vertical, diagonal planks shall be given for binding

1.1.4 Width of binding planks shall be minimum 100mm

1.1.5 Distance between any 2 binding planks shall be less than 750mm

1.1.6 Diagonal planks shall be used in between vertical binding planks when distance between inner to inner of vertical planks is more than 750mm

1.1.7 Distance of the outer edges of these planks from the edge of case shall be less than 250mm.

1.1.8 Diagonal planks are not required for top planks and width side, if the width of pallet is less than 750mm.

1.2 JOINTING OF PLANKS

Single length planks shall be used for cubicles whose overall length is less than 2400mm. For cubicles of length more than 2400mm, jointing is permitted. The jointing shall be done with one single or maximum of 2 planks of wood same as other planks of width 250 mm (minimum) with two rows of nails on either side of the joint in zigzag manner. From the joint along height side, it shall be of lap joint with overlap of at least the width of plank.

1.3 TONGUE AND GROOVE JOINTS

Two consecutive planks shall be joined by tongue and groove joint. Depth of tongue shall be 12+1 mm, thickness of tongue shall be 8 +1 mm. The groove dimensions shall be such that the tongue fits tightly into the groove to make a good joint. This type of joint can be done based on the product requirement wherever required.

1.4 PERMISSIBLE DEFECTS

Wood shall be free from knots, bows, visible sign of infection and any kind of decay caused by insects, fungus, etc. End splits: Longest end splits at each end shall be measured and lengths added together. The added length shall not exceed 60mm per meter run of shook's. Wood pins shall be used to prevent further development of split. Surface cracks: Surface cracks with a maximum depth of 3mm are permissible. A continuous crack of any depth all along the length is not allowed.

1.5 OTHER MATERIALS

1.5.1 NAILS

The dia. of the nails shall be 3.15mm. The length of the nails shall be 65mm wherever two planks of 25mm thickness are joined and 75mm wherever a 25mm planks is joined to a 50mm plank.

1.5.2 BLUE NAILS

These are used for nailing bituminized Kraft paper/hessian cloth to the planks. The length of the nails shall be 16mm.

1.5.3 HOOP IRON STRIPS

These are used for strapping the boxes. The width of the strips shall be 19+1mm and thickness 0.6+0.01mm. The material shall be free from rust. If sufficient nailing is done for bigger boxes, strapping need not be done.

1.5.4 CLIPS

These shall be used for strapping the hoop iron strips on the boxes.

1.5.5 BRACKETS

These brackets are used for nailing to the corners of cubicle boxes. The brackets shall be of mild steel of thickness min 2mm and width 25+1mm. The brackets shall be of “L" shape, the length of each side being 100+2mm. Two holes shall be provided towards the end of each side for screwing /nailing.

1.5.6 MULTI LAYERED CROSS LAMINATED POLYTHELENE FILM

100GSM (Colourless) Multi Layered Cross Laminated Polyethylene Film are used to make covers to the jobs individually. The cross lamination gives qualities of extra toughness, together with flexibility and lightness coupled with good weather resistance to ultra violet rays.

1.5.7 RUBBERISED COIR

The rubberized coir is used as cushioning material. For the packing of loose items, items are to be arrested by using rubberized coir. For the packing of cubicles rubberized coir of thickness 25mm and width 75mm shall be used.

1.5.8 FASTENERS

Bolts, double nuts, spring washers will have to be used to hold the job that there shall be no jerk.

1.5.8 PACKING SLIP

Packing slip kept in the polyethylene bag shall be placed in the box at appropriate place. In addition, one more packing slip covered in polyethylene cover and packing slip holder shall be nailed to front / rear of case.

1.5.9 MARKING PLATE

Marking on the packing case shall be done as per the manufacturer standard.

TITLE :	SPEC NO. : PE-TS-415-302-E001	
TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	VOLUME NO : II	
	SECTION : I	
1 X 660 MW BHUSAWAL TPS	REV – 0	DATE – 5.6.2020
	SHEET –	

DATA SHEET –A

11/3.45 kV OIL FILLED SERVICE TRANSFORMER

S. No.	Description	Unit	Particulars
1.0	Quantity	No. & kVA	2 nos. of 10000 KVA 2 nos. of 7500 KVA 2 nos. of 6300 KVA 4 nos. of 2000 KVA 2 nos. of 1000 KVA
2.0	Installation		Out Door
3.0	Type of insulating oil		Mineral
4.0	No. of phase	Nos	3
5.0	Frequency	Hz	50
6.0	Type of cooling		ONAN
7.0	Rated Voltage a) HV Winding b) LV Winding	 kV kV	 11.0 3.45
8.0	No Load transformation ratio		11/3.45
9.0	Vector group		Dyn11
10.0	Impedance voltage at rated current and frequency	%	10000 KVA - 9% 7500 KVA - 8% 6300 KVA - 8% 2000 KVA - 6% 1000 KVA - 6%
11.0	Total range of tapping's and tapping steps		± 5% in steps of 2.5%
12.0	Type of tap changing equipment		Off-Circuit
13.0	Temperature rise a) Top oil by thermometer b) Winding by resistance	 deg.C deg.C	 40 deg. C above ambient of 50 deg.C 45 deg. C above ambient of 50 deg.C
14.0	System Highest Voltage a) HV Winding b) LV Winding	 kV kV	 12 kV 3.6kV
15.0	Phase Connection a) HV Winding b) LV Winding		 Delta Star

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16.0	Insulation Levels		
16.1	One minute power frequency withstand voltage a) HV Winding b) LV Winding	 kV kV	 28 10
16.2	Impulse withstand voltage a) HV Winding b) LV Winding	 kVp kVp	 75 40
17.0	Terminal details a) HV Line b) HV Neutral c) LV Line d) LV Neutral		 Cable box (XLPE cables) N.A. Flange throat for TPN segregated Al Busduct Cable box (XLPE cables)
18.0	System Fault Level a) HV Winding b) LV Winding	 kA kA	 44 kA RMS 40 kA RMS
19.0	Method of System Earthing a) HV System b) LV System c) Through fault withstand time		 NA Low resistance earthed to limit earth fault current to 300A 2 Sec.
20.0	Details of Cooling Equipment radiators		Detachable tank mounted
21.0	Provision/ accommodation of CTs LV Neutral		2 Core PS CLASS or 5P20. CT particulars shall be given to Successful bidder during detail engineering. There shall be no commercial implication to BHEL on this account
22.0	Colour Shade : a) Interior (For M. Box) b) Exterior		 As mentioned in this specification As mentioned in this specification
23.0	Cable details (11KV/3.45KV) a) HV side i) Type ii) Voltage Grade iii) Conductor material & size iv) No. of cores & runs b) LV side c) LV Neutral i) Type		(Cable not in bidder scope of supply) XLPE 11kV Unearthed Stranded Aluminium 1-3C-240 sq mm (1 MVA transformer) 1-3C-240 sq mm (2 MVA transformer) 1-1C-300 sq mm/ph (6.3 MVA transformer) 1-1C-400/500 sq mm/ph (7.5 MVA transformer) 1-1C-630 sq mm/ph (10 MVA transformer) NA XLPE

	TITLE : **TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS** **1 X 660 MW BHUSAWAL TPS**	SPEC NO. : PE-TS-415-302-E001	
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	ii) Voltage Grade iii) Conductor material & size iv) No. of cores & runs		3.3kV Unearthed Stranded Aluminium, 1C-240 sq mm One core, single run
24.0	Penalty for Losses a) Rates for bid evalution b) i)'A' (for no load loss) ii) 'B' (for load losses) c) Rates for penalty i) 'A' (for no load loss) ii) 'B' (for load loss)		 N.A. losses not to exceed max losses as per annexure-B to section-II, vol-II of the specification - Do- INR 2,46,000/- per kW INR 2,46,000/- per kW
25.0	Creepage distance		31mm/kV
26.0	Method of Tap change Control a) Manual local b) Electrical local c) Electrical Remote d) Automatic		 Yes No No No
27.0	Type of tank construction (bell type or conventional tank with cover)		Convention tank with cover
28.0	Type of Oil preservation system		Bellows/ diaphragm sealed conservator with silica gel
29.0	TRANSFORMER BUSHING Voltage class kV(r.m.s.)		HV LV LV-N 17.5 7.2 7.2
30.0	Full power tapping provided		Yes

	TITLE :	SPEC NO. : PE-TS-415-302-E001	
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6.6/0.433 kV OIL FILLED SERVICE TRANSFORMER

S. No.	Description	Unit	Particulars
1.0	Quantity	No. & kVA	2 nos. of 630 KVA
2.0	Installation		Out Door
3.0	Type of insulating oil		Mineral
4.0	No. of phase	Nos	3
5.0	Frequency	Hz	50
6.0	Type of cooling		ONAN
7.0	Rated Voltage a) HV Winding b) LV Winding	 kV kV	 6.6 0.433
8.0	No Load transformation ratio		6.6/0.433
9.0	Vector group		Dyn11
10.0	Impedance voltage at rated current and frequency	%	6%
11.0	Total range of tapping's and tapping steps		± 5% in steps of 2.5%
12.0	Type of tap changing equipment		Off-Circuit
13.0	Temperature rise c) Top oil by thermometer d) Winding by resistance	 deg.C deg.C	 40 deg. C above ambient of 50 deg.C 45 deg. C above ambient of 50 deg.C
14.0	System Highest Voltage c) HV Winding d) LV Winding	 kV kV	 7 kV 415V + 10%
15.0	Phase Connection c) HV Winding d) LV Winding		 Delta Star
16.0	Insulation Levels		
16.1	One minute power frequency withstand voltage a) HV Winding b) LV Winding	 kV kV	 28 3
16.2	Impulse withstand voltage a) HV Winding b) LV Winding	 kVp kVp	 75 -
17.0	Terminal details a) HV Line b) HV Neutral		 Cable box (XLPE cables) N.A.

	TITLE : **TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS** **1 X 660 MW BHUSAWAL TPS**	SPEC NO. : PE-TS-415-302-E001
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	c) LV Line d) LV Neutral		Cable box (LT XLPE cable) One neutral with LT XLPE Cable and second neutral with copper earthing bar for system earthing brought near the base of transformer
18.0	System Fault Level a) HV Winding b) LV Winding	 kA kA	 40 kA RMS 50 kA RMS
19.0	Method of System Earthing a) HV System b) LV System c) Through fault withstand time		 Low resistance earthed to limit earth fault current to 300A Solidly grounded 2 Sec.
20.0	Details of Cooling Equipment radiators		Detachable tank mounted radiators
21.0	Provision/ accommodation of CTs LV Neutral		 2 Core PS CLASS or 5P20. CT particulars shall be given to successful bidder during detail engineering. There shall be no commercial implication to BHEL on this account
22.0	Colour Shade : a) Interior (For M. Box) b) Exterior		 As mentioned in this specification As mentioned in this specification
23.0	Cable details (6.6/0.433 kV) a) HV side i) Type i) Voltage Grade ii) Conductor material & size iii) No. of cores & runs b) LV side i) Type ii) Voltage Grade iii) Conductor material & size iv) No. of cores & runs		(Cable not in bidder scope of supply) XLPE 6.6kV Unearthed Stranded Aluminium Shall be informed after award of contract Three core, one run XLPE 1.1kV Unearthed Stranded Aluminium Shall be informed after award of contract Single core per phase, two run
24.0	Penalty for Losses a) Rates for bid evalution b) i) 'A' (Losses at 50% Load & 75°C) ii) 'B' (Losses at 100% Load & 75°C)		 N.A. Losses not to exceed max. losses as per Energy Efficiency Level-2 as per IS-1180 - Do-
25.0	Creepage distance		31mm/kV

	TITLE :	SPEC NO. : PE-TS-415-302-E001	
	TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	VOLUME NO : II	
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DATA SHEET –B
TECHNICAL PARTICULARS
[TO BE SUBMITTED ALOGWITH TECHNICAL OFFER]

FOR 11/3.45 kV

S. No	Description	Unit	Requirement	To be filled by bidder
1.	Rating	MVA	1 / 2 / 6.3 / 7.5 / 10	#
2.	No Load transformation ratio	kV	11/3.45	
3.	Maximum No- load losses at rated frequency and 100% rated voltage	kW	1.5 kW (Max.) for 1 MVA 2.4 kW (Max.) for 2 MVA 6.5 kW (Max.) for 6.3 MVA 7.2 kW (Max.) for 7.5 MVA 9.0 kW (Max.) for 10 MVA	
4.	Maximum load losses at normal ratio, rated current and 75 deg. C	kW	12.0 kW (Max.) for 1 MVA 24.0 kW (Max.) for 2 MVA 45.0 kW (Max.) for 6.3 MVA 50.0 kW (Max.) for 7.5 MVA 72.0 kW (Max.) for 10 MVA	
5.	Overall Dimensions	mm x mm x mm		
6.	Total weight	kg		
7.	Total oil Quantity	kg		

To be separately filled for each rating transformer

FOR 6.6/0.433 kV

S. No	Description	Unit	Requirement	To be filled by bidder
1.	Rating	kVA	630	
2.	No Load transformation ratio	kV	6.6/0.433	
3.	Losses at 50% Load & 75°C (Watts)	W	Energy Efficiency Level-2 as per IS-1180	
4.	Losses at 100% Load & 75°C (Watts)	W		
5.	Overall Dimensions	mm x mm x mm		
6.	Total weight	kg		
7.	Total oil Quantity	kg		

DATA SHEET - C

TECHNICAL PARTICULARS

TO BE SUBMITTED AFTER AWARD OF CONTRACT

1 X 660 MW BHUSAWAL TPS

OIL FILLED SERVICE TRANSFORMER

SR.NO.	ITEM	UNIT	
1.1	GENERAL		
1.1.1	Make		
1.1.2	Type		
1.1.3	Number of Winding per Phase		
1.1.4	Number of Phase		
1.1.5	Number of Unit per set		
1.1.6	Reference Standard		
1.2	RATING		
1.2.1	Type of Cooling		
1.2.2	Rated Output		
(a)	With ONAN Cooling	MVA	
(b)	With ONAF Cooling	MVA	
(c)	With OFAN Cooling	MVA	
(d)	With OFAF Cooling	MVA	
1.2.3	Rated Voltage		
(a)	H.V.	kV	
(b)	L.V.	kV	

SR.NO.	ITEM	UNIT	
1.2.4	Rated Current		
(a)	H.V.	Amps.	
(b)	L.V.	Amps.	
1.2.5	Rated Frequency	Hz	
1.2.6	Connection		
(a)	H.V.		
(b)	L.V.		
1.2.7	Vector Group Reference		
1.2.8	Voltage Withstand Time		
(a)	110% of rated voltage	Sec.	
(b)	125% of rated voltage	Sec.	
(c)	140% of rated voltage	Sec.	
(d)	150% of rated voltage	Sec.	
1.2.9	Overfluxing Capability		
(a)	For Overfluxing Factor 1.1	Sec.	
(b)	For Overfluxing Factor 1.25	Sec.	
(c)	For Overfluxing Factor 1.4	Sec.	
1.3	TEMPERATURE		
1.3.1	Reference Ambient Temperature	Deg.C	
1.3.2	Temperature rise over reference ambient		

SR.NO.	ITEM	UNIT	
(c)	Of Top oil by thermometer	Deg.C	
(d)	Of winding by resistance	Deg.C	
1.3.3	Maximum continuous over loading capacity of the transformer without exceeding the specified winding temperature		
1.4	TAPPINGS		
1.4.1	Type		
1.4.2	Capacity		
1.4.3	Range - Steps x % Variation		
1.4.4	Taps provided on HV/LV Winding		
1.5	INSULATION LEVEL		
1.5.1	H.V.	kVp/kV	
1.5.2	L.V.	kVp/kV	
1.5.3	H.V. Neutral	kVp/kV	
1.5.4	L.V. Neutral	kVp/kV	
1.6	IMPEDANCES AT PRINCIPAL TAP AT RATED FREQUENCY AND 75 DEG.C WINDING TEMPERATURE	%	
1.6.1	Base MVA		

SR.NO.	ITEM	UNIT	
1.6.2	Impedance		
1.6.3	Reactance		
1.6.4	Resistance at 75 Deg.C		
1.6.5	Zero Sequence Impedance at 75 Deg.C		
1.6.6	Capacitance of Windings		
(a)	H.V. – Earth	micro farad/ph	
(b)	L.V. – Earth	micro farad/ph	
(c)	H.V. - L.V.	micro farad/ph	
1.7	Guaranteed Losses at Principal Tap, Full Load and 75 Deg.C		
1.7.1	No load losses	kW	
1.7.2	Load losses	kW	
1.7.3	Cooler losses	kW	
1.7.4	Tolerance on losses	kW	
1.8	Efficiency at 75 Deg.C and 0.8 Power Factor Lag		
1.8.1	At full load	%	
1.8.2	At full load	%	
1.8.3	At 1/2 full load	%	
1.8.4	Maximum Efficiency		

SR.NO.	ITEM	UNIT	
(a)	Load and Power Factor at which it occurs	%	
1.9	REGULATION AT FULL LOAD AT 75 Deg.C		
1.9.1	At unity power factor	%	
1.9.2	At 0.8 power factor lagging	%	
1.10	NO LOAD CURRENT REFERRED TO HV		
1.10.1	At 90% rated voltage	Amps.	
1.10.2	At 100% rated voltage	Amps.	
1.10.3	At 110% rated voltage	Amps.	
1.10.4	At 125% rated voltage	Amps.	
1.10.5	At 140% rated voltage	Amps.	
1.11	APPROXIMATE MAXIMUM FLUX DENSITY		
1.11.1	At 90% rated voltage	Wb/Sq.m	
1.11.2	At 100% rated voltage	Wb/Sq.m	
1.11.3	At 110% rated voltage	Wb/Sq.m	
1.11.4	At 125% rated voltage	Wb/Sq.m	
1.11.5	At 140% rated voltage	Wb/Sq.m	
1.12	MAXIMUM CURRENT DENSITY		
1.12.1	H.V. Winding	Amps/Sq. cm	
1.12.2	L.V. Winding	Amps/Sq. cm	

SR.NO.	ITEM	UNIT	
1.13	WITHSTAND TIME WITHOUT INJURY FOR		
1.13.1	Three phase dead short-circuit at terminal with rated voltage maintained on the other side	Sec.	
1.13.2	Single phase short-circuit at terminal with rated voltage maintained on other side	Sec.	
1.14	COOLING SYSTEM		
1.14.1			
(a)	No. x Capacity of cooling unit furnished		
(b)	No. of cooling units required for full load operation		
1.14.2	Each Cooling Unit is provided with		
(a)	No. x kW of oil pump motor		
(b)	No. x kW of fan motor		
(c)	No. of standby fan		
(d)	No. of standby oil pumps		
1.14.3	Motors rated for voltage-phase-frequency		
1.14.4	Automatic Operation of cooler pumps and fans provided?		

SR.NO.	ITEM	UNIT	
1.14.5	Transformer is capable of delivering rated output under following conditions		
(a)	Failure of all pumps and fans of one cooling unit		
	(i) Continuous in % rated	MVA	
	(ii) Rated output for	min	
(b)	Failure of one complete cooling unit including radiator, fans, pumps etc.		
	(i) Continuous in % rated	MVA	
	(ii) Rated output for	min	
(c)	Failure of fans and pumps of all the cooler units		
	(i) Continuous in % rated	MVA	
	(ii) Rated output for	min	
(d)	Failure of complete cooling system including radiators, fans, pumps, etc.		
	(i) Continuous in % rated	MVA	
	(ii) Rated output for	min	
1.14.6	Schematic Flow Diagram of the Cooling System Furnished?		

SR.NO.	ITEM	UNIT	
1.14.7	Oil Pumps		
(a)	Make		
(b)	Type		
(c)	Catalogue Furnished		
1.15	DETAILS OF TANK		
1.15.1	Material		
1.15.2	Thickness of sides	mm	
1.15.3	Thickness of bottom	mm	
1.15.4	Thickness of cover	mm	
1.15.5	Tank Designed for		
(a)	Vacuum	mm of Hg	
(b)	Pressure		
1.16	CORE		
1.16.1	Type - Core or shell		
1.16.2	Core material		
1.16.3	Thickness of lamination	mm	
1.16.4	Insulation of lamination		
1.16.5	Equivalent cross-sectional area		
1.17	COILS		
1.17.1	Type of Coil		
(a)	H.V.		

SR.NO.	ITEM	UNIT	
(b)	L.V.		
1.17.2	Conductor Material		
1.17.3	Insulating Material		
(a)	H.V. – Turn		
(b)	L.V. – Turn		
(c)	L.V. – Earth		
(d)	H.V. - L.V.		
(e)	H.V. Earth		
1.18	TAP CHANGER		
1.18.1	Make		
1.18.2	Type		
1.18.3	Rated Voltage	kV	
1.18.4	Rated Current	Amps.	
1.18.5	Auxiliary Power	kW	
1.18.6	Time required for one step change	Secs.	
1.18.7	Rated Voltage		
(a)	Tap-change motor	Volts	
(b)	Control circuit	Volts	
1.18.8	Control		
(a)	Manual/Local Electrical/ Remote Electrical		

SR.NO.	ITEM	UNIT	
(b)	Group/Solo		
1.18.9	Voltage Control Automatic/Non-automatic		
1.18.10	Provision for parallel operation		Yes/No
1.18.11	Maximum Short Circuit Current withstand capability		
(a)	Current	kA	
(b)	Time	sec	
1.18.12	Loose equipment and provisions for remote control furnished as per specification?		
1.18.13	Local manual operation feasible from standing height from ground?		
1.18.14	Local indicator furnished for		
(a)	Tap position		
(b)	Operation counter		
1.18.15	In case of off-circuit tap changer		
(a)	Padlocking provided		Yes/No
(b)	Auxiliary switch for interlock provided		Yes/No
(c)	Safety limit switch provided		Yes/No
(d)	Discrepancy detector provided		Yes/No

SR.NO.	ITEM	UNIT	
1.18.16	In case of On-load tap changer		
(a)	Interlocks as per specification provided		Yes/No
(b)	Voltage Regulating relay provided		
	(i) Make		
	(ii) Type		
	(iii) Sensitivity (Dead band) and nominal value range		
	(iv) Timer range		
	(v) Literature furnished?		
(c)	Under voltage Relay		
	(i) Voltage range		
	(ii) Timer range		
1.19	INSULATING OIL		
1.19.1	Approximate volume Litre		
1.19.2	10% excess oil furnished?		Yes/No
1.19.3			
(a)	Oil conforms to		
(b)	Details of oil furnished		Yes/No
1.19.4			
(a)	Oil preservation system provided?		Yes/No

SR.NO.	ITEM	UNIT	
(b)	Type		
1.20	BUSHINGS H V/LV HVN/LVN		
1.20.1	Make		
1.20.2	Type		
1.20.3	Reference Standard		
1.20.4	Voltage class	kV	
1.20.5	Type of atmosphere		
1.20.6	Creepage Distance	mm	
1.20.7	Weight	kg	
1.20.8	Free space required for bushing removal		
1.20.9	Test terminals for H.V. bushing provided?		
1.20.10	One minute power frequency withstand voltage	kV rms	
1.20.11	Impulse withstand voltage	kVp	
1.21	MINIMUM CLEARANCE		
1.21.1	Between Phases		
(a)	In air		
	(i) HV	mm	
	(ii) LV	mm	
(b)	In oil		
	(i) HV	mm	

SR.NO.	ITEM	UNIT	
	(ii) LV	mm	
1.21.2	Between Phase & Earth		
(a)	In air		
	(i) HV	mm	
	(ii) LV	mm	
(b)	In oil		
	(i) HV	mm	
	(ii) LV	mm	
1.22	TERMINAL CONNECTIONS		
1.22.1	H.V.		
1.22.2	L.V.		
1.22.3	H.V. Neutral		
1.22.4	L.V. Neutral		
1.23	MARSHALLING BOX		
1.23.1	Weatherproof, suitable for outdoor duty		
1.23.2	Degree of protection		
1.24	TERMINAL BLOCKS		
1.24.1	Make		
1.24.2	Type		
1.24.3	20% spare terminals furnished?		Yes/No

SR.NO.	ITEM	UNIT		
1.25	WIRING			
1.25.1	Cable type			
1.25.2	Voltage grade	Volt		
1.25.3	Conductor Size	Sq.mm		
(a)	Material			
(b)	Stranded		Yes/No	
1.26	Trip and Alarm Contacts Ratings		220V DC	240V AC
1.26.1	Voltage	Volt		
1.26.2	Rated			
(a)	Making Current	Amps.		
(b)	Breaking Current (Inductive Breaking)	Amps.		
1.27	ACCESSORIES Each transformer furnished with fittings and accessories as per specification?		Yes/No	
1.28	DETAIL OF CONSERVATOR			
1.28.1	Volume of Conservator			
1.28.2	Volume of oil between the highest and lowest levels			
1.29	PRESSURE RELEASE DEVICE			
(a)	Minimum pressure the device is set to operation/rupture	kN/Sq.m		

SR.NO.	ITEM	UNIT	
(b)	Alarm and trip contacts provided		
1.30	SPARE PARTS Each transformer furnished with spare parts as per specification		
1.31	APPROXIMATE OVERALL DIMENSION		
1.31.1	Length	mm	
1.31.2	Breadth	mm	
1.31.3	Height	mm	
(a)	Crane lift (a) for untanking core and coil assembly (including sling) (b) tank cover in case of Bell type tank	mm	
1.32	APPROXIMATE WEIGHTS		
1.32.1	Core and Coil	kg	
1.32.2	Tank cover for Bell type tank	kg	
1.32.3	Tank and fittings	kg	
1.32.4	Oil	kg	
1.32.5	Total Weight	kg	
1.33	SHIPPING DATA		
1.33.1	Weight of the heaviest package	kg.	

SR.NO.	ITEM	UNIT	
1.33.2	Dimension of the largest package (L x B x H)	mm	
1.34	Tests to be conducted on each Transformer		
1.34.1	Routine tests as per specification / relevant standard		
1.34.2	Tank pressure test on each transformer		
(a)	Test Pressure	kN/Sq.m	
(b)	Duration	Hours	
(c)	Permanent deflection		
1.34.3	Tank vacuum test on each transformer		
(a)	Vacuum	kN/Sq.m	
(b)	Duration	Hours	
(c)	Permanent deflection		
1.34.4	Oil leak test on each transformer		
(a)	Test pressure		
(b)	Duration		
1.34.5	Core bolt withstand voltage for 1 minute on each transformer	kV	

SR.NO.	ITEM	UNIT	
1.35	NEUTRAL CURRENT TRANSFORMER		
1.35.1	General		
1.35.2	Make		
1.35.3	Type		
1.35.4	Reference Standard		
1.35.5	Use		
1.35.6	Rating		
(a)	C.T. Ratio		
(b)	Class		
(c)	Insulation level		
(d)	Burden		
1.35.7	Insulation Class		
(a)	Temperature rise at rated burden over top oil temperature	Deg.C	
1.35.8	Characteristics		
(a)	Secondary resistance Rct Ohm at 75 Deg.C	Ohms	
(b)	Knee point voltage Vk	Volt	
(c)	Excitation current at Vk/2	Amps.	
1.35.9	Dimensions and Weights		
(a)	Dimension (L x B x H)	mm	

SR.NO.	ITEM	UNIT	
(b)	Weight	kg.	
(c)	Tests		
	As per Standard?		

SECTION ‘II’

STANDARD TECHNICAL SPECIFICATION

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	TITLE : STANDARD TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	SPECIFICATION NO. PE-SS-999-302-E001
		VOLUME NO. : II
		SECTION : II
		REV NO. : 00 DATE : 30/06/2016
		SHEET : 2 of 30

1.00.00 SCOPE

1.01.00 This specification covers the design, manufacture, inspection & testing, packing at manufacturer's works and delivery to site of mineral oil filled service Transformers complete with all fittings & accessories for satisfactory operation at site.

1.02.00 **TERMINAL POINTS**

1.02.01 HV bushings with terminal connector for bus duct/ cable glands & lugs in case of cable connection.

1.02.02 LV bushings with terminal connector (3 Phase + 1 Neutral) for bus duct/ cable glands & lugs in case of cable connection.

1.02.03 For HV Earthing : (Applicable in case of star connection of HV) - neutral earth busbar brought near the base of transformer/ Cable glands & lugs in case of cable connection.

1.02.04 For LV Earthing : - neutral earth busbar brought near the base of transformer/ Cable glands & lugs in case of cable connection

1.02.05 Transformer earthing pads.

1.02.06 Terminals of marshalling box for external connection to equipment supplied by the purchaser.

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	TITLE :	SPECIFICATION NO.
BHEL	**STANDARD TECHNICAL SPECIFICATION FOR** **OIL FILLED SERVICE TRANSFORMERS**	**PE-SS-999-302-E001**
		VOLUME NO. : **II**
		SECTION : II
		REV NO. : **00** DATE : 30/06/2016
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2.00.00 CODES AND STANDARDS

S.NO.	STANDARD NUMBER	STANDARD TITLE
1	IS:2026 IEC: 60076	POWER TRANSFORMERS
2	IS:1180	OUTDOOR TYPE OIL IMMERSED DISTRIBUTION TRANSFORMERS UPTO AND INCLUDING 2500 kVA, 33kV - SPECIFICATION
2	IS:6600	GUIDE FOR LOADING OF OIL IMMERSED TRANSFORMER
3	IS:3639	FITTINGS & ACCESSORIES FOR POWER TRANSFORMER
4	IS:335 IEC: 60296	NEW INSULATING OILS
5	IS:2099 IEC: 60137	Bushing for alternative voltage above 1000 volts
6	IS: 3347	Dimension for porcelain transformer bushings
7	IS:2705 IEC: 60185	Current transformers
8	IS: 3637	Gas operated relays
9	IS:1271 IEC: 60216	Classification of insulating material for electrical machinery & apparatus in relation to their thermal stability in service
10	IS/IEC: 60529	Classification of degrees of protection provided by enclosures of electrical equipment
11	IS:2071 IEC: 60060	Method of high voltage testing
12	IS: 5	Colours for ready mixed paints & enamels
13	NEMA, STANDARD-TR1	Noise level
14	CBIP Publication (latest edition)	Manual on transformers

2.01.00 The equipment shall comply with all currently applicable safety codes and statutory regulations of India as well as of the locality where the equipment is to be installed including India n Electricity Act , Indian Electricity Rules and Bureau of Indian Standards.

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	TITLE : STANDARD TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	SPECIFICATION NO. PE-SS-999-302-E001
		VOLUME NO. : II
		SECTION : II
		REV NO. : 00 DATE : 30/06/2016
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3.00.00 TECHNICAL REQUIREMENTS

3.01.00 Technical particulars of transformers are specified in Data Sheet –A of section-I, volume-II.

3.02.00 All windings shall be fully insulated. Material of the windings shall be electrolytic grade copper, free from scales and burrs. Winding shall be uniformly insulated.

3.03.00 The core shall be constructed from high grade, non-ageing, cold rolled, grain oriented silicon steel laminations.

3.04.00 Internal design of transformer shall ensure that air is not trapped in any location.

3.05.00 Nuts, bolts and pins used inside the transformer shall be provided with lock washers & locknuts

3.06.00 **Tank**

3.06.01 Under base of tank shall be fixed type.

3.06.02 Tank shall be of welded construction & fabricated from tested quality low carbon steel of adequate thickness. Tank shields, if provided, shall not resonate at natural frequency of equipment.

3.06.03 All steel surfaces in contact with insulating oil shall be painted with two coats of heat resistant oil in soluble insulating varnish.

3.06.04 Auxiliary transformers shall have suitable bi-directional skids, however auxiliary transformers above 2 MVA shall be provided with four no. of bi-directional detachable flat rollers. Suitable locking arrangement shall be provided to prevent accidental movement of transformer.

3.06.05 At least two adequately sized inspection openings, one at the each end of the tank for easy access to bushings and earth connections & suitable manhole shall be provided.

3.06.06 The main tank body including tap-changer compartment, radiators and coolers shall be capable of withstanding full vacuum.

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	TITLE : STANDARD TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	SPECIFICATION NO. PE-SS-999-302-E001
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3.06.07 All tank and oil filled compartment shall be tested for oil tightness by being completely filled wit h oil of visc osity n ot greater than th at of specified oi l at the ambient temperature and a pplying pre ssure eq ual to t he normal press ure pl us 35 kN/m2 measured at the base of the tank.

3.07.00 **Tank mounting**

Tank shall also be provided with lifting lugs and minimum four jacking pads. Rollers shall be provided with holding clamp plates (04 nos), required hardware and foundation bolts etc. for each transformer.

3.08.00 **Oil preservation**

Conservator tank of adequate capacity for expansion of oil from minimum ambient to 100 deg. C sha ll be p rovided. Th e tra nsformers ra ted 6. 3MVA and above s hall b e provided with air ba g bre athing through s ilica gel br eather. For lo wer rating transformers with conventional conservator with dry air filling of the space above oil and connected to silica gel breather shall be provided.

3.09.00 **Radiators**

The radiators shall be detachable type, mounted on the tank. Each radiator shall be provided with a drain plug/valve at the bottom, an air release plug at the top, shut off valve at each point of connection to the tank.

3.10.00 **Insulating Oil**

As per IS: 335. No external inhibitors are permitted.

3.11.00 All transformers shall be suitable for cable/ busduct termination as indicated in data sheet-A of section-I, volume-II.

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	TITLE : STANDARD TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	SPECIFICATION NO. PE-SS-999-302-E001
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3.12.00 **Bushings/ Insulators**

3.12.01 The bushings shall conform to the requirements of IS: 2099 and IS: 3347 and shall be of porcelain and above 3150A for the LV bushing Epoxy bushing shall also be acceptable.

3.12.02 For 33kV windings 36kV bushing shall be provided. For 3.3kV, 6.6kV and 11 kV windings, 17.5kV bushing shall be provided. For 415V windings, 1.1kV bushings shall be provided.

3.12.03 The porcelain shall not engage directly with hard metal and, wherever necessary, gaskets shall be interposed between the porcelain and the fitting.

3.12.04 Clamps and fittings of steel or malleable cast iron shall be galvanised.

3.12.05 Where bushing current transformer is provided, the bushing shall be mounted so that it can be removed and replaced without disturbing the current transformers. CTs shall be cast resin type & suitable for operation at ambient temperature existing at its location on the transformer.

3.12.06 Creepage distance shall be as per data sheet-A of section-I, volume-II.

3.12.07 Minimum rated current for bushings shall be as under. However, same shall comply with IS-2099 and HV/LV system fault current mentioned in Clause No. 20.00 of Datasheet A of section-I, volume-II:

1) H V Bushing for 33kV
   7.5 MVA = 250A
   5.0 MVA = 100A
   2.0 MVA = 100A

2) H V Bushing for 11kV & 6.6kV
   10.0MVA= 1000A
   8.0MVA = 1000A
   7.5MVA = 800A
   6.3MVA = 800A
   5.0MVA = 630A
   3.5MVA = 250A
   2.5 MVA = 250A

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2.0 MVA = 250A
1.6 MVA = 250A
1.0 MVA = 100A
630 kVA = 100A

2) H V Bushing for 3.3kV
2.5 MVA = 630A
2.0 MVA = 500A
1.6 MVA = 400A
1.0 MVA = 250A
630 kVA = 250A

3) L V Bushing for 11kV, 6.6kV & 3.3kV

10.0MVA= 2500A
8.0MVA = 2000A
7.5MVA = 1600A
6.3MVA = 1600A
5.0MVA = 1250A
3.5MVA= 1250A

4) L V Bushing for 433V/420V
2.5 MVA = 4000A
2.0 MVA = 4000A
1.6 MVA = 3150A
1.0 MVA = 2000A
630 kVA = 1000A

3.13.00 **Cable Box**

3.13.01 A dust tight air insulated type cable box with D.O.P. of IP: 55 shall be provided for terminating the cables directly of size and type specified in Data sheet-A of section-I, volume-II. The cable box shall also be provided with a suitable canopy. Suitable cable glands (double compression type) and lugs shall be provided for cable termination.

3.13.02 Dimensions of cable box shall be subject to purchaser's approval.

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3.13.03 Inspection cover for fixed portion of cable box shall be provided. Handles for lifting cable box shall be provided.

3.13.04 Creepage distance shall be as per data sheet-A of section-I, volume-II.

3.13.05 Provision shall be made for earthing the body of each cable box. Separate earthing pads shall be provided for this purpose, suitable for bolted connection to galvanised mild steel flat of size to be specified during contract engineering stage.

3.13.06 Gland plate for single core cable termination shall be of Aluminium.

3.13.07 Cable box(es) shall be provided with suitable air-insulated disconnecting chamber so that if required, transformer can be removed from its position without disconnecting the cables in the cable box(es). Independent supporting arrangement shall be provided for cable box(es) for this purpose. Supporting arrangement shall be supplied along with required hardware & foundation bolts etc.

3.14.00 **Busduct Termination**

If LV terminals are specified to be connected by means of a busduct, a flanged throat or equivalent connection shall be provided to suit purchaser's busducts. The winding termination shall be on outdoor type of bushing. Necessary flexibles shall be provided by purchaser to connect the bushing terminals to the busbars of the busduct. Details of bus duct shall be furnished during detail engineering stage. Degree of protection of LV busduct flange enclosure shall be IP:55.

3.15.00 **Neutral Terminals**

Two (2) nos. neutral terminals shall be provided on LV side. One neutral terminal shall be part of phase connection arrangement busduct throat/ LV cable-box (as applicable). Other neutral terminal shall be in a separate box and brought to tank bottom by means of earthing bar of 50x6 mm of copper, supported on porcelain insulators mounted on transformer tank. The neutral earthing bar brought to the tank bottom for connection to station earth shall be provided with holes and suitable connecting hardware. This earthing bar shall have fork type arrangement at the end. However neutral may be connected to NGR as per system requirement.

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3.16.00 **Neutral CT**

Bidder to provide neutral bushing CT as per details given in data sheet – A of section-I, volume-II for restricted earth fault protection or standby earth fault protection. In case neutral CT is tank mounted, CT box shall be weather proof having D.O.P. IP: 55. The Neutral CT box shall also be provided with a suitable canopy. CTs shall be cast resin type.
All CTs (except WTI) shall be mounted in the turret of bushings, mounting inside the tank is not permitted.

3.17.00 **Valves**

3.17.01 All valves upto and including 50 mm shall be of gun metal or of cast steel. Larger valves may be of gun metal or may have cast iron bodies with gun metal fittings.

3.17.02 Sampling & drain valves should have zero leakage rate.

3.18.00 **Gaskets**

3.18.01 Gasket shall be fitted with weather proof, hot oil resistant, rubberized cork.

3.18.02 If gasket is compressible, metallic stops shall be provided to prevent over compression.

3.18.03 The gaskets shall not deteriorate during the life of transformer/shunt reactor if not opened for maintenance at site. All joints flanged or welded associated with oil shall be such that no oil leakage or sweating occurs during the life of transformer.

3.19.00 **Voltage control (off circuit type)**

3.19.01 Off circuit tap-changing switch shall be three phase, hand operated, for simultaneous switching of similar taps on all the three phases by operating an external handle/ hand wheel. The position of off-circuit tap switch handle/hand wheel provided outside the transformer tank should be such as to enable an operator standing on ground to operate the same with ease. A caution plate indicating that switch shall be operated only when the transformer is de-energised shall be fitted near tap switch.

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3.19.02 Operating mechanism of tap changer shall be suitably labelled to show the direction of operation for raising secondary voltage & vice versa. Position markings shall be provided.

3.19.03 Arrangement shall be made for securing and padlocking the tap-changing switch at any working position. It shall not be possible to set and padlock in any intermediate position.

3.19.04 Tap position indicator and mechanical stops to prevent over-cranking of the mechanism shall be provided.

3.20.00 **Marshalling box**

3.20.01 Tank mounted vermin and dust proof marshalling box shall be provided to accommodate indication circuits and temperature indicators etc. and provided with proper lighting and thermostatically controlled space heaters.

3.20.02 The marshalling box shall be fabricated using sheet steel of at least 2.5mm thickness. The marshalling box shall have domed or sloping roof.

3.20.03 Marshalling box shall be complete with all internal wiring and identification ferrules, cables, conduits required for wiring between marshalling box and instruments on transformer. Wiring shall be by 1100 V grade, copper cable of size 2.5mm^2.

3.20.04 The terminal blocks shall be complete with insulating barriers and clip-on type terminals suitable for 2.5mm^2 stranded copper wire. One dummy terminal block in between each trip wire terminal shall be provided. At least 20% spare terminals shall be provided on each panel. The gasket used shall be of neoprene rubber.

3.20.05 The marshalling box shall have IP: 55 degree of protection.

3.20.06 CT terminals shall be with shorting and disconnecting facility. TB shall be stud type for all CT & power connection.

3.20.07 Wiring scheme shall be engraved in a stainless steel plate with viewable font size and the same shall be fixed inside the Marshalling Box door. Refer annexure-C for standard terminal block numbering.

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3.21.00 **Flux density**

Flux density in any part of the core & yoke on any tap position with ±10% voltage variation from voltage corresponding to the tap shall not exceed 1.9 Wb/m^2. Transformer shall also withstand following conditions due to combined voltage and frequency variations:

Continuous operation for 110% flux density
At least 1 minute operation for 125% flux density
At least 5 sec. operation for 140% flux density

3.22.00 **Winding**

For 33kV, 11kV & 3.3kVwinding, type of winding shall be continuous disc & for 433V/ 420V winding, type of winding shall be spiral type. The conductors shall be of Electrolytic grade copper.

3.23.00 **Noise & Vibration**

The design and manufacture of transformer, fittings and accessories shall be such as to reduce noise & vibration. Noise level shall not be more than as specified in NEMA Standard Publication TR-1, when measured with transformer energised at normal voltage and frequency.

3.24.00 All transformers and their accessories shall be capable of withstanding without damage any external short circuit at the terminals for duration of two seconds.

3.25.00 Maximum Transformer losses including tolerances shall be as per annexure – B, of section-I, volume-II.

3.26.00 **LOADING CAPABILITY**

Transformer shall be suitable for continuous operation at rated kVA on any tap with voltage variation of $\pm$ 10 % corresponding to voltage of the tap. Short duration overloading shall be in accordance with IS:6600 / IEC60076-7.

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4.00.00 **Fittings & accessories**

4.01.00 Transformer shall be provided with, but not restricted to following minimum fittings and accessories for satisfactory operation:

4.01.01 Conventional type conservator with drain valve and oil filling hole.

4.01.02 Magnetic oil level gauge with low-level alarm contact.

4.01.03 Prismatic & toughened glass oil level gauge.

4.01.04 Gaskets

4.01.05 Gasket protection covers.

4.01.06 Silica gel breather with oil seal.

4.01.07 Double float type Buchholz relay with alarm and trip contacts with suitable gas collecting device with two shut-off valve on both side.

4.01.08 Diaphragm type explosion vent for transformers of rating less than 2MVA

4.01.09 Pocket on tank cover for thermometer.

4.01.10 Protected type mercury in glass thermometer.

4.01.11 Dial type (150 mm) Oil temperature indicator (OTI) with two sets of electrical potential- free contact rated for 2A, 220V DC, for alarm and trip purpose. The OTI shall be provided with anti-vibration mounting. OTI shall have maximum reading pointer along with resetting device. For remote oil temperature metering, an independent 4-20 mA should be made available.

4.01.12 Dial type (150 mm) Winding temperature indicator (WTI) with two sets of electrical potential- free contact rated for 2A, 220V DC, for alarm and trip purpose. The WTI shall be provided with anti-vibration mounting. WTI shall have maximum reading position along with resetting devices. For remote winding temperature metering, an independent 4-20 mA should be made available.

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4.01.13 Drain Valves.

4.01.14 Sampling devices.

4.01.15 Filter valves.

4.01.16 Earthing terminals – 2 Nos.

4.01.17 Rating & Diagram plates.

4.01.18 Valve schedule plate.

4.01.19 Two sets of lifting lugs (one for transformer with oil and other for tank cover).

4.01.20 Jacking pads.

4.01.21 Skids and pulling eyes on both sides.

4.01.22 Air release devices.

4.01.23 Inspection cover.

4.01.24 Oil filling hole and cap.

4.01.25 Tank mounted marshalling box.

4.01.26 Detachable, flat, bidirectional rollers with 90 deg. swivel mechanism.

4.01.27 Clamping arrangement for rollers.

4.01.28 Ground support for cable box.

4.01.29 Neutral CT secondary box.

4.01.30 Haulage facilities.

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4.01.31 Two nos. spring operated pressure relief devices with extension pipe to bring oil to plinth level along with electrically insulated contact for alarm and tripping for transformer rating 2 MVA and above.

4.01.32 Gas collection device along with all accessories**.**

4.02.00 Breather shall be fitted at a height not exceeding 1.5 M.

4.03.00 Rating and diagram plate shall be fitted at a height of about 1.75 M above the ground level.

4.04.00 The WTI and OTI shall have accuracy class of $\pm$ 2 deg. C or better.

4.05.00 Rating/ Name/ Valve schedule plates shall be of white non-hygroscopic material with engraved black lettering . Su ch plates sh all b e b i- lingu al (requ irement will be finalised d uring de tailed e ngineering) w ith Hindi inscription first, followed b y English. Alternatively, two separate plates with Hindi & English inscription shall be provided.

5.00.00 **PAINTING**

Paint s hade shal l be informed to su ccessful bi dder during det ail e ngineering as applicable for s pecific pr oject. Adequate q uantity of touch u p pa int shall also be supplied. There shall be no commercial or delivery implication to BHEL on account of paint shade, paint specification/ procedure.

6.00.00 **QUALITY ASSURANCE, TESTING & INSPECTION**

6.01.00 BHEL's Standard QP (PE-QP-999-302-E001 Rev. 0) is enclosed as per Annexure-A of section-II, volume-II for reference. In case bidder has reference QP agreed with ultimate customer, same can be submitted for specific project after award of contract for BHEL/ ultimate customer's approval. There shall be no commercial or delivery implication to BHEL on account of QP approval.

6.02.00 All m aterials, com ponents a nd accessories of th e tra nsformers shall be p rocured, manufactured, inspected and tested by vendor/ sub-vendor as per approved quality plan.

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6.03.00 Tests shall be performed in presence of Purchaser's representative. The bidder shall give at least fifteen (15) days advance notice of date when the tests are to be carried out.

6.04.00 All routine and acceptance tests as per relevant standards and specification shall be carried out by the vendor/ sub-vendor on all transformers.

6.05.00 Successful bi dder s hall fur nish Li st of s ub-vendors/ m akes of it ems f or BHE L/ customer approval at contract stage. This shall not have any commercial implication to BHEL.

6.06.00 For a cceptance of sho rt c ircuit repo rts fo r te sts c arried out earli er on simil ar transformers, successful bi dder s hall furnish the fo llowing documents for BHEL/ BHEL's customer acceptance without any commercial/ delivery implication to BHEL

6.06.01 Calculations an d d esign considerations t o prove ab ility to withstand t he dynamic effects of short circuit.

6.06.02 Short circuit test report of previously tested similar transformer for validation by comparison. Criteria for similarity of transformer for acceptance of Short circuit test report shall be as given in the Annexure-B of IEC-60076-5.

7.00.00 COMMISSIONING SPARES, SPECIAL TOOLS & TACKLES AND O & M SPARES

7.01.00 Commissioning spares are those, which may be required during commissioning of the equipment. Bidder to furnish list of commissioning spares along with technical offer as per annexure-IV of section-I, volume-II.

7.02.00 The b idder shall sup ply with the equ ipment, one unused com plete set of all special tools & tackles required for the erection, a ssembly, disa ssembly and pr oper maintenance of the e quipment. A li st of such tools & tackles (price deem ed to be included in the total bid price) shall be submitted by the bidder along with the offer as per annexure-V of section-I, volume-II.

7.03.00 O & M spares are those which are required for satisfactory & trouble free operation of equipment. List of O & M spares is enclosed as per Annexure-D of section-II, volume-II. O & M spares shall be quoted (if applicable) as per BOQ-cum-price schedule as part of NIT.

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8.00.00 O & M MANUALS

8.01.00 O & M manuals for the installation, operation and maintenance of transformers shall be furnished at least three months before despatch of equipment.

8.02.00 Draft manual should first be submitted for purchaser's approval. The manual should contain minimum following details:

8.02.01 General description of equipment.

8.02.02 Approved Technical Data Sheet

8.02.03 All drawings

8.02.04 Salient constructional features.

8.02.05 Technical leaflets of fittings/ important parts.

8.02.06 Type and routine test certificates.

8.02.07 Instructions to be followed on receipt of equipment at site & for storage.

8.02.08 Instructions for foundation arrangement.

8.02.09 Erection procedures and checks.

8.02.10 Pre-commissioning checks.

8.02.11 Commissioning procedures.

8.02.12 Withdrawal arrangement/ material handling instructions.

8.02.13 Operation instructions.

8.02.14 Maintenance instructions.

8.02.15 Trouble-shooting.

8.02.16 Safety instructions.

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ANNEXURE - A

STANDARD QUALITY PLAN

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO :PE-TS-415-302-E001	DATE: 23/06/2020
	CUSTOMER : MAHAGENCO		QP NO.: PE-V0-415-302-E901, REV. 00	DATE: 26/06/2020
	PROJECT: 1X660MW BHUSAWAL TPS		PO NO.:	DATE:
	ITEM: OIL FILLED TRANSFORMER	SYSTEM:	SECTION: II	SHEET No. of

S. NO.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.0	RAW MATERIALS & BOUGHT OUT ITEMS													
1.1	MILD STEEL PLATE, MS PIPE, CHANNELS, MS ANGLES	1. THICKNESS	MA	MEASUREMENT	10%	10%	Manf. Std / IS:2062 / IS:1239	Manf. Std / IS:2062 / IS:1239	QC RECORD	✓	P	V	V	
		2. SURFACE DEFECTS	MA	VISUAL	100%	-			QC RECORD		P	-	-	
		3. CHEMICAL COMPOSITION	MA	TEST	As per IS/ Plant Std	-			SUPPLIER'S TEST CERT.		V	-	-	
		4. MECHANICAL PROPERTIES	MA	TEST	-do-	-			SUPPLIER'S TEST CERT.		V	-	-	
		5. HYDRAULIC TEST OF PIPES	MA	TEST	-do-	-			SUPPLIER'S TEST CERT.		V	-	-	
1.2	CRGO STEEL	1. THICKNESS & FINISH	MA	MEASUREMENT	10%	10%	DRG/DATA SHEET/ Manf. Std / IS:3024 / IS:649 / IEC60404	DRG/DATA SHEET/ Manf. Std / IS:3024 / IS:649 / IEC60404	QC RECORD	✓	P	V	V	
		2. GRADE OF CRGO	MA	MEASUREMENT	-	-			SUPPLIER'S TEST CERT.	✓	V	-	-	
		3. CUTTING & BURR	MA	MEASUREMENT	10%	-			QC RECORD		V	-	-	
		4. SCRATCHES, SURFACE FINISH	MA	VISUAL	10%	-			SUPPLIER'S TEST CERT.		V	-	-	
		5. WAVINESS & EDGE CAMBER	MA	MEASUREMENT	10%	-			SUPPLIER'S TEST CERT.		V	-	-	
		6. SPECIFIC CORE LOSS	MA	TEST	As per IS/ Plant Std	As per IS/ Plant Std			SUPPLIER'S TEST CERT.	✓	V	V	V	
		7. SURFACE RESISTIVITY	MA	TEST	As per IS/ Plant Std	-			SUPPLIER'S TEST CERT.		V	-	-	
		8. STACKING FACTOR	MA	TEST	As per IS/ Plant Std	-			SUPPLIER'S TEST CERT.		V	-	-	
		9. PERMEABILITY	MA	TEST	As per IS/ Plant Std	-			SUPPLIER'S TEST CERT.		V	-	-	
		10. BEND TEST/ DUCTILITY	MA	MEASUREMENT	As per IS/ Plant Std	-			SUPPLIER'S TEST CERT.		V	-	-	

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL				
ENGINEERING			QUALITY			Sign & Date		Doc No:				
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal	
Prepared by:		Nitish Manu	Checked by:		Kundan Prasad			Reviewed by:				
Reviewed by:		Kanhaiya Kumar/Manish Shukla	Reviewed by:		Ritesh Kumar Jaiswal			Approved by:				

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO :PE-TS-415-302-E001	DATE: 23/06/2020
	CUSTOMER : MAHAGENCO		QP NO.: PE-V0-415-302-E901, REV. 00	DATE: 26/06/2020
	PROJECT: 1X660MW BHUSAWAL TPS		PO NO.:	DATE:
	ITEM: OIL FILLED TRANSFORMER	SYSTEM:	SECTION: II	SHEET No. of

S. NO.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.3	PAPER INSULATED COPPER CONDUCTOR	1. DIMENSIONS	MA	MEASUREMENT	100%	100%	Manf. Std / IS:13730-P-27/IEC 60554/IEC 60317	Manf. Std/ IS:13730-P-27/IEC 60554/IEC 60317	QC RECORD	✓	P	V	V	
		2. RESISTIVITY/CONDUCTIVITY		TEST	10%	10%	-DO-	-DO-	SUPPLIER'S TEST CERT.	✓	V	V	V	
		3. ELONGATION	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		4. TENSILE STRENGTH	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		5. PROOF STRESS IF APPLICABLE	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		6. INSULATION TEST BETWEEN STRANDS FOR BUNCHED CONDUCTORS	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		7. CU PURITY OF CC ROD	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		8. CHEMICAL COMPOSITION	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		9. PAPER COVERING	MA	VISUAL	100%	-			SUPPLIER'S TEST CERT.		V	-	-	
		10. SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM SHARP EDGE,BURR,SCRATCH, CUTS ETC.	FREE FROM SHARP EDGE,BURR,SCRATCH, CUTS ETC.	QC RECORD/SUPPLIER'S TEST CERT		V	-	-	
1.4	INSULATING PAPER	1. DIMENSIONS	MA	MEASUREMENT	10%	10%	Manf. Std / IS:9335-P-2/IS:9335-P-III/IEC 60554	Manf. Std / IS:9335-P-2/IS:9335-P-III/IEC 60554	QC RECORD/SUPPLIER'S TEST CERT	✓	P	V	V	
		2. DENSITY AND SUBSTANCE	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V			
		3. TENSILE STRENGTH	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V			
		4. ELONGATION	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V			
		5. WATER ABSORPTION	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V			

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		Nitish Manu	Checked by:		Kundan Prasad
Reviewed by:		Kanhaiya Kumar/Manish Shukla	Reviewed by:		Ritesh Kumar Jaiswal

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO :PE-TS-415-302-E001	DATE: 23/06/2020
	CUSTOMER : MAHAGENCO		QP NO.: PE-V0-415-302-E901, REV. 00	DATE: 26/06/2020
	PROJECT: 1X660MW BHUSAWAL TPS		PO NO.:	DATE:
	ITEM: OIL FILLED TRANSFORMER	SYSTEM:	SECTION: II	SHEET No. of

S. NO.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		6. MOISTURE CONTENT	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		7. PH VALUE & CONDUCTIVITY AQUEOUS EXTRACT	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		8. ASH CONTENT	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		9. ELECTRICAL STRENGTH	MA	TEST	As per IS/ Plant Std	As per IS/ Plant Std	-DO-	-DO-	SUPPLIER'S TEST CERT.	✓	V	V	V	
		10. AIR PERMEABILITY	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		11. TEAR INDEX	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		12. HEAT STABILITY	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
1.5	INSULATION & PRESS BOARD MOULDING (STOCK ITEMS)	1. DIMENSION	MA	MEASUREMENT	10%	10%	Manf. Std / IS:1576/ IEC 60641	Manf. Std / IS:1576/ IEC 60641	QC RECORD/SUPPLIER'S TEST CERTIFICATE	✓	P	V	V	
		2. COMPRESSIBILITY	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		3. DENSITY	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		4.TENSILE STRENGTH	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		5.PH VALUE/CONDUCTIVITY OF WATER EXTRACT	MA	TEST	As per IS/ Plant Std	As per IS/ Plant Std	-DO-	-DO-	SUPPLIER'S TEST CERT.	✓	V	V	V	
		6. ELECTRICAL STRENGTH IN AIR & OIL	MA	TEST	As per IS/ Plant Std	As per IS/ Plant Std	-DO-	-DO-	SUPPLIER'S TEST CERT.	✓	V	V	V	
		7.SHRINKAGE IN AIR	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		8.FLEXIBILITY	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		Nitish Manu	Checked by:		Kundan Prasad
Reviewed by:		Kanhaiya Kumar/Manish Shukla	Reviewed by:		Ritesh Kumar Jaiswal

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL				
Doc No:				
	Sign & Date	Name	Seal	
Reviewed by:				
Approved by:				

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO :PE-TS-415-302-E001	DATE: 23/06/2020
	CUSTOMER : MAHAGENCO		QP NO.: PE-V0-415-302-E901, REV. 00	DATE: 26/06/2020
	PROJECT: 1X660MW BHUSAWAL TPS		PO NO.:	DATE:
	ITEM: OIL FILLED TRANSFORMER	SYSTEM:	SECTION: II	SHEET No. of

S. NO.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		9. ASH CONTENT	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		10.MOISTURE CONTENT	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		11. COHESION BETWEEN PLIES	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		12. ELONGATION	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		13. OIL ABSORPTION	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
1.6	DENSIFIED WOOD	1. DIMENSION	MA	MEASUREMENT	10%	-	Manf. Std / IS:3513/ IEC61061	Manf. Std / IS:3513/ IEC61061	QC RECORD		P	-	-	
		2. SURFACE FINISH	MA	VISUAL	10%	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		P	-	-	
		3. ELECTRICAL STRENGTH IN OIL	MA	TEST	As per IS/ Plant Std	As per IS/ Plant Std	-DO-	-DO-	SUPPLIER'S TEST CERT.	✓	P	V	V	
		4. OIL ABSORPTION	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		P	-	-	
		5. MOISTURE CONTENT	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		6. COMPRESSION STRENGTH	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		7. CROSSBREAKING STRENGTH	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		8.TENSILE STRENGTH	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		9.SHRINKAGE IN AIR AND OIL	MA	TEST	As per IS/ Plant Std	-			SUPPLIER'S TEST CERT.		V	-	-	
		10. SPECIFIC GRAVITY/ DENSITY	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		Nitish Manu	Checked by:		Kundan Prasad
Reviewed by:		Kanhaiya Kumar/Manish Shukla	Reviewed by:		Ritesh Kumar Jaiswal

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL				
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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO :PE-TS-415-302-E001	DATE: 23/06/2020
	CUSTOMER : MAHAGENCO		QP NO.: PE-V0-415-302-E901, REV. 00	DATE: 26/06/2020
	PROJECT: 1X660MW BHUSAWAL TPS		PO NO.:	DATE:
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					M	C/N				D	M	C	N	
1.7	GASKET (RUBBER BONDED CORK SHEET) (IF APPLICABLE)	1. DIMENSION	MA	MEASUREMENT	10%		Manf. Std / IS:4253	Manf. Std / IS:4253	QC RECORD		P	-	-	REFER APPROVED OGA / DATA SHEET FOR APPLICABILITY
		2. HARDNESS	MA	TEST	As per IS/ Plant Std	As per IS/ Plant Std	-DO-	-DO-	SUPPLIER'S TEST CERT.	✓	V	V	V	
		3. TENSILE STRENGTH	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		4. COMPRESSIBILITY	MA	TEST	As per IS/ Plant Std	As per IS/ Plant Std	-DO-	-DO-	SUPPLIER'S TEST CERT.	✓	V	V	V	
		5. RECOVERY	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		6. COMPRESSION SET	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		7. FLEXIBILITY	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		8. FLUID RESISTANCE TEST	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		9. CHLORIDE/SULPHATE CONTENT OF WATER EXTRACT	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		10. ACCELERATED AGING TEST IN OIL	MA	TEST	As per IS/ Plant Std	-			SUPPLIER'S TEST CERT.		V	-	-	
		11. DENSITY	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
1.8	NITRILE RUBBER CORD AND "O" RING(IF APPLICABLE)	1. DIMENSION	MA	MEASUREMENT	10%	-	Manf. Std / IS:4253	Manf. Std / IS:4253	SUPPLIER'S TEST CERT.		P	-	-	REFER APPROVED OGA / DATA SHEET FOR APPLICABILITY
		2. SHORE HARDNESS	MA	TEST	As per IS/ Plant Std	As per IS/ Plant Std	-DO-	-DO-	SUPPLIER'S TEST CERT.	✓	P	V	V	
		3. TENSILE STRENGTH	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		4. ELONGATION AT BREAK	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
		5. COMPRESSION SET	MA	TEST	As per IS/ Plant Std	As per IS/ Plant Std	-DO-	-DO-	SUPPLIER'S TEST CERT.	✓	V	V	V	
		6. ACCELERATED AGEING IN OIL	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL				
ENGINEERING			QUALITY			Sign & Date		Doc No:				
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal	
Prepared by:		Nitish Manu	Checked by:		Kundan Prasad			Reviewed by:				
Reviewed by:		Kanhaiya Kumar/Manish Shukla	Reviewed by:		Ritesh Kumar Jaiswal			Approved by:				

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO :PE-TS-415-302-E001	DATE: 23/06/2020
	CUSTOMER : MAHAGENCO		QP NO.: PE-V0-415-302-E901, REV. 00	DATE: 26/06/2020
	PROJECT: 1X660MW BHUSAWAL TPS		PO NO.:	DATE:
	ITEM: OIL FILLED TRANSFORMER	SYSTEM:	SECTION: II	SHEET No. of

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1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.9	INSULATING OIL	1. APPEARANCE OF OIL	MA	VISUAL	ONE SAMPLE	ONE SAMPLE	IEC60296 / IS335	IEC60296 / IS335	SUPPLIER'S TEST CERT.	✓	V	V	V	
		2. DENSITY AT 29.5 DEG C	MA	TEST			IS 1448(16)	IS 1448(16)	SUPPLIER'S TEST CERT.	✓	V	V	V	
		3. KINEMATIC VISCOSITY AT 27 DEG C	MA	TEST			IS 1448(25)	IS 1448(25)	SUPPLIER'S TEST CERT.	✓	V	V	V	
		4. INTERFACIAL TENSION AT 27 DEG C	MA	TEST			IS 6104	IS 6104	SUPPLIER'S TEST CERT.	✓	V	V	V	
		5. FLASH POINT	MA	TEST			IS 1448(21)	IS 1448(21)	SUPPLIER'S TEST CERT.	✓	V	V	V	
		6. POUR POINT	MA	TEST			IS 1448(10)	IS 1448(10)	SUPPLIER'S TEST CERT.	✓	V	V	V	
		7. NEUTRALIZATION VALUE	MA	TEST			IS 1448(2)	IS 1448(2)	SUPPLIER'S TEST CERT.	✓	V	V	V	
		8. CORROSIVE SULPHUR	MA	TEST			IS 335	IS 335	SUPPLIER'S TEST CERT.	✓	V	V	V	
		9. DIELECTRIC DISSIPATION FACTOR	MA	TEST			IS 6262	IS 6262	SUPPLIER'S TEST CERT.	✓	V	V	V	
		10. SPECIFIC RESISTANCE (RESISTIVITY)	MA	TEST			IS 6103	IS 6103	SUPPLIER'S TEST CERT.	✓	V	V	V	
		11. AGEING CHARACTERISTICS AFTER ACCELERATED AGING	MA	TEST			IS 12177	IS 12177	SUPPLIER'S TEST CERT.	✓	V	V	V	
		12. OXIDATION STABILITY	MA	TEST			IS 335	IS 335	SUPPLIER'S TEST CERT.	✓	V	V	V	
		13. PRESENCE OF OXIDATION INHIBITOR	MA	TEST			IS 13631	IS 13631	SUPPLIER'S TEST CERT.	✓	V	V	V	
		14. ELECTRIC STRENGTH (BDV, TAN-DELTA) I) AS DELIVERED II) AFTER TREATMENT	MA	TEST			IS 6262	IS 6262	SUPPLIER'S TEST CERT.	✓	V	V	V	
		15. WATER CONTENT	MA	TEST			IS 13567	IS 13567	SUPPLIER'S TEST CERT.	✓	V	V	V	
		16. S.K.VALUE	MA	TEST			IS 335 /IEC:60296	IS 335/ IEC:60296	SUPPLIER'S TEST CERT.	✓	V	V	V	

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Prepared by:		Nitish Manu	Checked by:		Kundan Prasad				Reviewed by:			
Reviewed by:		Kanhaiya Kumar/Manish Shukla	Reviewed by:		Ritesh Kumar Jaiswal				Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO :PE-TS-415-302-E001	DATE: 23/06/2020
	CUSTOMER : MAHAGENCO		QP NO.: PE-V0-415-302-E901, REV. 00	DATE: 26/06/2020
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					M	C/N				D	M	C	N	
1.10	PAINT & VARNISH	SHELF LIFE	MA	VISUAL	100%	100%	MANF.STD	MANF.STD	SUPPLIER'S TEST CERT.	✓	P	V	V	
2	**FITTING AND ACCESSORIES**													
2.1	PORCELAIN BUSHING (IF APPLICABLE)	1. DIMENSION	MA	MEASUREMENT	100%		APPROVED DRAWING/ IS:2099/IS:8603/IS:3347/IS 12676 / IEC60137 / IEC 60660	APPROVED DRAWING/ IS:2099/IS:8603/IS:3347/IS 12676 / IEC60137 / IEC 60660	SUPPLIER'S TEST CERT./ QC RECORD		P	-	-	REFER APPROVED DRAWING OF HV AND LV BUSHING FOR APPLICABILITY
		2. VISUAL DEFECTS	MA	VISUAL	100%	-			QC RECORD		V	-	-	
		3. ROUTINE TESTING	MA	TEST	100%	100%			SUPPLIER'S TEST CERT.	✓	V	V	V	
2.2	BUCHHOLZ RELAY	1. TYPE, SIZE & MAKE	MA	VISUAL	100%	100%	Manf. Std./ IS:3637	Manf. Std./ IS:3637	QC RECORD/SUPPLIER'S TEST CERTIFICATE	✓	P	V	V	
		2. CONTINUITY FOR ALARM & TRIP (PERFORMANCE)	MA	TEST	As per IS/ Plant Std	As per IS/ Plant Std			SUPPLIER'S TEST CERT.	✓	V	V	-	
		3. POROSITY TEST	MA	TEST	As per IS/ Plant Std	As per IS/ Plant Std			SUPPLIER'S TEST CERT.	✓	V	V	-	
		4. HIGH VOLTAGE & IR TEST	MA	TEST	As per IS/ Plant Std	As per IS/ Plant Std			SUPPLIER'S TEST CERT.	✓	V	V	-	
		5. ELEMENT TEST	MA	TEST	As per IS/ Plant Std	As per IS/ Plant Std			SUPPLIER'S TEST CERT.	✓	V	V	-	
		6. GAS VOLUME TEST	MA	TEST	As per IS/ Plant Std	As per IS/ Plant Std			SUPPLIER'S TEST CERT.	✓	V	V	V	
		7. LOSS OF OIL & SURGE TEST	MA	TEST	As per IS/ Plant Std	As per IS/ Plant Std			SUPPLIER'S TEST CERT.	✓	V	V	-	

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1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
2.3	PRESSURE RELIEF DEVICE	1. TYPE, SIZE & MAKE	MA	VISUAL	100%	100%	Manf. Std	Manf. Std	QC RECORD	✓	P	V	V	
		2. OPERATION (PRESSURE & FLAG INDICATION)	MA	TEST	As per IS/ Plant Std				SUPPLIER'S TEST CERT.		V	-	-	
		3. HV TEST	MA	TEST	As per IS/ Plant Std				SUPPLIER'S TEST CERT.		V	-	-	
		4. SWITCH CONTACT OPERATION	MA	TEST	As per IS/ Plant Std	As per IS/ Plant Std			SUPPLIER'S TEST CERT.	✓	V	V	V	
2.4	MAGNETIC OIL LAVEL GAUGE (MOG)	1. TYPE, SIZE & MAKE	MA	VISUAL	100%	-	Manf. Std	Manf. Std	QC RECORD		P	-	-	
		2. DIAL MARKING	MA	VISUAL	10%	-			SUPPLIER'S TEST CERT.		V	-	-	
		3. SWITCH CONTINUITY	MA	TEST	10%	-			SUPPLIER'S TEST CERT.		V	-	-	
		4. HV TEST	MA	TEST	10%	-			SUPPLIER'S TEST CERT.		V	-	-	
		5. OPERATION TEST	MA	TEST	10%	-			SUPPLIER'S TEST CERT.		V	-	-	
2.5	OFF-CIRCUIT TAP CHANGER/SWITCH ~~(IF APPLICABLE)~~	1. DIMENSIONS	MA	MEASUREMENT	100%	100%	Manf. Std / IEC 60214	Manf. Std / IEC 60214	QC RECORD	✓	P	V	V	~~REFER APPROVED DATA SHEET FOR APPLICABILITY~~
		2. PHYSICAL CONDITION	MA	VISUAL	100%				QC RECORD		V	-	-	
		3. OPERATION OF SWITCH	MA	TEST	-do-				QC RECORD		V	-	-	
		4. INSULATION RESISTANCE TEST	MA	TEST	-do-				SUPPLIER'S TEST CERT.		V	-	-	
		5. LEAK TEST OF HANDLE STUFFING BOX	MA	TEST	-do-				SUPPLIER'S TEST CERT.		V	-	-	
		6. MILLI VOLT DROP TEST	MA	TEST	-do-				SUPPLIER'S TEST CERT.	✓	V	V	V	
~~2.6~~	~~ON LOAD TAP CHANGER (IF APPLICABLE)~~	~~1. VISUAL CHECK~~	~~MA~~	~~VISUAL~~	~~100%~~	~~100%~~	~~IS:8468/IEC 60214~~	~~IS:8468,/IEC 60214~~	~~QC RECORD~~	~~ü~~	~~P~~	~~V~~	~~V~~	~~REFER APPROVED DATA SHEET FOR APPLICABILITY~~
		~~2. DIMENSIONAL CHECK~~	~~MA~~	~~MEASUREMENT~~	~~100%~~	~~100%~~			~~SUPPLIER'S TEST CERT.~~	~~ü~~	~~P~~	~~V~~	~~V~~	
		~~3. MECHANICAL OPERATION ON DIVERTER & SELECTOR SWITCH, 4000 SWITCHING OPER. (MIN)~~	~~MA~~	~~VERIFY~~	~~-do-~~				~~SUPPLIER'S TEST CERT.~~		~~P~~	-	-	
		~~4. HV TEST ON AUXILIARY CIRCUIT~~	~~MA~~	~~TEST~~	~~-do-~~				~~SUPPLIER'S TEST CERT.~~		~~P~~	-	-	
		~~5. SEQUENCE TEST~~	~~MA~~	~~TEST~~	~~-do-~~				~~SUPPLIER'S TEST CERT.~~		~~P~~	-	-	
		~~6. PRESSURE TEST OF DIVERTER SWITCH COMPARTMENT WITH OIL~~	~~MA~~	~~TEST~~	~~-do-~~				~~SUPPLIER'S TEST CERT.~~		~~P~~	-	-	

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO :PE-TS-415-302-E001	DATE: 23/06/2020
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					M	C/N				D	M	C	N	
		~~7. MECHANICAL TEST OF TAP SELECTOR WITH MOTOR DRIVE 500 SATISFACTORY OPM(IN ALL) FROM ONE EXTREME POSITION TO THE OTHER IN AIR~~	~~MA~~	~~TEST~~	~~do~~		~~IS:8468/IEC 60214~~	~~IS:8468/IEC 60214~~	~~SUPPLIER'S TEST CERT.~~		~~P~~	-	-	
		~~8. OPM TEST OF COMPLETE TAPCHANGER~~	~~MA~~	~~TEST~~	~~do~~				~~SUPPLIER'S TEST CERT.~~		~~P~~	-	-	
		~~9. AUX. CKT. HV TEST AT 2 KV FOR 1 MIN.~~	~~MA~~	~~TEST~~	~~do~~				~~SUPPLIER'S TEST CERT.~~		~~P~~	-	-	
2.7	GUN METAL / CAST IRON VALVES GATE/GLOBE/ BUTTERFLY)	1. DIMENSIONAL CHECK	MA	MEASUREMENT	100%	-	Manf. Std./IS:778(1)	Manf. Std./IS:778(1)	QC RECORD		P	-	-	
		2. TYPE, SIZE & MAKE	MA	VISUAL	100%	100%	-DO-	-DO-	QC RECORD	✓	P	V	V	
		3. LEAKAGE TEST(HYDRAULIC TEST FOR BODY & SEAT)	MA	TEST	As per IS/ Plant Std	As per IS/ Plant Std	IS 778(1)	IS 778(1)	SUPPLIER'S TEST CERT.	✓	V	V	V	
		4. OPERATIONAL TEST (CLOSE & OPEN)	MA	TEST	As per IS/ Plant Std	-	-DO-	-DO-	SUPPLIER'S TEST CERT.		V	-	-	
2.8	BUSHING CT	1. VISUAL CHECK/DIMENSIONAL CHECK	MA	MEASURE/VISUAL TEST	As per IS/ Plant Std	-	Manf. Std./IS:2705/IEC 60044	Manf. Std./IS:2705/IEC 60044	SUPPLIER'S TEST CERT.	✓	V	V	V	
		2. ROUTINE TEST	MA	TEST	100%	100%	Manf. Std./IS:2705	Manf. Std./IS:2705	SUPPLIER'S TEST CERT.	✓	V	V	V	
2.9	MARSHALING BOX/~~RTCC~~	1. VISUAL CHECK FOR WIRING	MA	TEST	100%	100%	APPROVED DRAWING	APPROVED DRAWING	QC RECORD	✓	P	V	V	
		2. DIMENSIONAL CHECK	MA	MEASURE/TEST	100%	100%	APPROVED DRAWING	APPROVED DRAWING	QC RECORD	✓	P	V	V	
		3. CHECK FOR MAKE OF COMPONENTS	MA	MEASURE/TEST	100%	100%	APPROVED DRAWING	APPROVED DRAWING	QC RECORD	✓	P	V	V	
		4. 2 KV INSULATION TEST ON AUXILIARY WIRING	MA	MEASURE/TEST	100%	100%	APPROVED DRAWING	SHOULD WITHSTAND FOR 1 MINUTE	QC RECORD	✓	P	V	V	
		5. CHECK FOR PAINT SHADE & THICKNESS	MA	MEASURE/TEST	100%	100%	APPROVED DRG./MANF. STD.	APPROVED DRG./MANF. STD.	QC RECORD	✓	P	V	V	
		6. DEGREE OF PROT. BY PAPER INSERTION	MA	MEASURE/TEST	100%	100%	MANF. STD.	MANF. STD.	QC RECORD	✓	P	V	V	
2.10	OTI & WTI	1. TYPE SIZE & MAKE	MA	VISUAL	100%	100%	APPROVED DRG./MANF. STD.	APPROVED DRG./MANF. STD.	QC RECORD	✓	P	V	V	
		2. HV TEST	MA	TEST	As per IS/ Plant Std	As per IS/ Plant Std	Manf. Std./ IS11222/ IS 2848	Manf. Std./ IS11222/ IS 2848	SUPPLIER'S TEST CERT.	✓	V	V	V	
		3. TEMPERATURE CALIBRATION	MA	TEST	As per IS/ Plant Std	As per IS/ Plant Std	Manf. Std./ IS11222/ IS 2848	Manf. Std./ IS11222/ IS 2848	SUPPLIER'S TEST CERT.	✓	V	V	V	
		4. SWITCH SETTING & SWITCH DEFERENTIAL	MA	TEST	As per IS/ Plant Std	As per IS/ Plant Std	Manf. Std./ IS 2848	Manf. Std./ IS 2848	SUPPLIER'S TEST CERT.	✓	V	V	V	
		5. CALIBRATION & OPERATION OF SWITCH	MA	TEST	As per IS/ Plant Std	As per IS/ Plant Std	Manf. Std./ IS 2848	Manf. Std./ IS 2848	SUPPLIER'S TEST CERT.	✓	V	V	V	

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Reviewed by:		Kanhaiya Kumar/Manish Shukla	Reviewed by:		Ritesh Kumar Jaiswal

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO :PE-TS-415-302-E001	DATE: 23/06/2020
	CUSTOMER : MAHAGENCO		QP NO.: PE-V0-415-302-E901, REV. 00	DATE: 26/06/2020
	PROJECT: 1X660MW BHUSAWAL TPS		PO NO.:	DATE:
	ITEM: OIL FILLED TRANSFORMER	SYSTEM:	SECTION: II	SHEET No. of

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1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
2.11	RADIATOR	1. TYPE, MODEL, RATING	MA	VISUAL	100%	100%	APPROVED DRG./MANF. STD.	APPROVED DRG./MANF. STD.	QC RECORD	✓	P	V	V	
		2. DIMENSIONS & NO. OF ELEMENTS	MA	TEST	100%	100%	APPROVED DRG./MANF. STD.	APPROVED DRG./MANF. STD.	QC RECORD	✓	V	V	V	
		3. PAINT SHADE, FINISH & FILM THICKNESS	MA	TEST	100%	100%	APPROVED DRG./MANF. STD.	APPROVED DRG./MANF. STD.	QC RECORD	✓	V	V	V	
		4. PRESSURE TEST	MA	TEST	100%		APPROVED DRG./MANF. STD.	APPROVED DRG./MANF. STD.	SUPPLIER'S TEST CERT.		V	-	-	
		5. ADHESION TEST ON PAINT	MA	TEST	100%		IS 101	IS 101	QC RECORD		V	-	-	
2.12	HARDWARE	1. DIMENSIONAL CHECK	MA	MEASUREMENT	100%	-	Manf. Std.	Manf. Std.	QC RECORD		V	-	-	
		2. TENSILE STRENGTH	MA	TEST	-	-	Manf. Std.	Manf. Std.	SUPPLIER'S TEST CERT.		V	-	-	
2.13	SILICAGEL BREATHER	1. TYPE, SIZE, MODEL	MA	VISUAL	10%	-	Manf. Drg./docs/Spec	Manf. Drg./docs/Spec	QC RECORD		V	-	-	
		2. PRESSURE/ LEAKAGE TEST	MA	TEST	-do-	-			SUPPLIER'S TEST CERT.		V	-	-	
		3. COLOUR OF SILICA GEL	MA	VISUAL	-do-	-			SUPPLIER'S TEST CERT.		V	-	-	
2.14	ROLLER ASSEMBLY	1. DIMENSIONAL CHECK	MA	MEASUREMENT	100%	-	Manf. Std.	Manf. Std.	QC RECORD		V	-	-	
3	IN-PROCESS													
3.1	FABRICATION OF TANK, CONSERVATOR,RADIATOR, HV&LV CABLE BOX AND WELDING REQUIREMENT	1. WELDING PROCEDURE SPECIFICATION	MA	VERIFY/REVIEW	100%	100%	ASME Sec-IX	ASME Sec-IX	QC RECORD	✓	V	V	V	
		2. PROCESS QUALIFICATION RECORD	MA	VERIFY/REVIEW	100%	100%	ASME Sec-IX	ASME Sec-IX	QC RECORD	✓	V	V	V	
		3. WELDER QUALIFICATION	MA	VERIFY/REVIEW	100%	100%	ASME Sec-IX	ASME Sec-IX	QC RECORD	✓	V	V	V	
		4. WELDING ELECTRODES-MECHANICAL PROPERTIES	MA	VERIFY/REVIEW	100%	-	As per WPS/ IS:814	As per WPS/ IS:814	SUPPLIER'S TC		V	-	-	
		5. FITUP FOR BUTT WELD JOINTS OF TANK AND COVER	MA	VISUAL	100%	-	Mfg. Dwg./ Std.	MANF. DRG./STAND.	QC RECORD		V	-	-	
		6. VISUAL CHECK ON WELDMENT & ANY FOREGIN PARTICLE IN THE ENTIRE TANK WITH CONSERVATOR, PIPES ETC.AND BLANKING OF ENDS WITH BOLTED PLATES	MA	VISUAL	100%	-	Mfg. Dwg./ Std.	MANF. DRG./STAND.	QC RECORD		V	-	-	
		7. DIMENSIONAL CHECK AFTER FINAL WELDING INCL.FOUNDATION DIMENSION-HV & LV CABLE BOX/ RADIATOR/ COOLER/ PIPES	MA	MEASUREMENT	100%	100%	Mfg. Dwg./ Std.	MANF. DRG./STAND.	QC RECORD	✓	V	V	V	
		8. DP TEST ON WELDED JOINTS	MA	TEST	100%	100%	Mfg. Dwg./ Std./ IS:3658	MANF. DRG./STAND../ IS:3658	QC RECORD	✓	V	V	V	
		9. CHECK FOR FLATNESS GASKET SURFACE	MA	VISUAL	100%	-	Mfg. Dwg./ Std.	MANF. DRG./STAND.	QC RECORD		V	-	-	
		10. RIM FLATNESS	MA	MEASUREMENT	100%	-	Mfg. Dwg./ Std.	MANF. DRG./STAND.	QC RECORD		V	-	-	

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Reviewed by:		Kanhaiya Kumar/Manish Shukla	Reviewed by:		Ritesh Kumar Jaiswal

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					M	C/N				D	M	C	N	
		11. SURFACE CLEANING BY SAND/ SHOT BLASTING	MA	VISUAL	100%	100%	MANF. DRG./STAND.	MANF. DRG./STAND.	QC RECORD	✓	V	V	V	
		12. PRIMER COATING, PAINT SHADE THICKNESS INSIDE & OUTSIDE	MA	MEASUREMENT	100%	100%	IS:101/ BHEL specification	IS:101/ BHEL specification	QC RECORD	✓	V	V	V	
		13. PAINT FILM ADHESION TEST	MA	TEST	100%	100%	IS:101/ BHEL specification	IS:101/ BHEL specification	QC RECORD	✓	V	V	V	
		14. VACUUM TEST (TANK)	CR	VACCUM TEST	~~1 UNIT EACH TYPE~~ 100%	~~1 UNIT EACH TYPE~~ 100%	CBIP/ IS:1180	CBIP/ IS:1180	QC FORMAT	✓	P/V	W	W	PL. REFER SEC-I, ANNEX-III, CL NO, 5.1.2 FOR DETAILS
		15. PRESSURE TEST (TANK)	CR	PRESSURE TEST	~~1 UNIT EACH TYPE~~ 100%	~~1 UNIT EACH TYPE~~ 100%	CBIP/ IS:1180	CBIP/ IS:1180	QC FORMAT	✓	P/V	W	W	PL. REFER SEC-I, ANNEX-III, CL NO, 5.1.2 FOR DETAILS
3.2	CORE STAMPING	1. BURR & BOW	MA	VISUAL	100%	-	MANF. DRG./STAND.	MANF. DRG./STAND.	QC RECORD		P	-	-	
		2. DIMENSIONAL CHECK	MA	MEASUREMENT	100%	-			QC RECORD		P	-	-	
3.3	CORE BUILDING	1. DIMENSIONAL CHECK	MA	MEASUREMENT	100%	-	MANF. DRG./STAND.	MANF. DRG./STAND.	QC RECORD		P	-	-	
		2. ASSEMBLY OF LIMB INSULATION AND LIMB PLATES.	MA	VISUAL	100%	-			QC RECORD		P	-	-	
		3. RECTANGULARITY OF CORE ASSEMBLY	MA	VISUAL	100%	-			QC RECORD		P	-	-	
		4. FREEDOM FROM OVERLAPS & AIR GAP AT JOINTS	MA	VISUAL	100%	-			QC RECORD		P	-	-	
		5. LEANING OF CORE (I.E CORE VERTICALITY)	MA	VISUAL	100%	-			QC RECORD		P	-	-	
		6. LIMB & STACK THICKNESS	MA	VISUAL	100%	-			QC RECORD		P	-	-	
		7. LIMB CLAMPING & BINDING	MA	VISUAL	100%	-			QC RECORD		P	-	-	
		8. CORE DIAMETER	MA	VISUAL	100%	100%			QC RECORD	✓	P	V	V	
		9. EARTHING OF CORE	MA	VISUAL	100%	100%			QC RECORD	✓	P	V	V	
3.4	TEST OF CORE	1. DIMENSIONAL CHECK	MA	MEASURE	100%	-	MANF. DRG./STAND.	MANF. DRG./STAND.	QC RECORD		P	-	-	
		2. FLUX DENSITY MEASUREMENT	MA	MEASURE	100%	-			QC RECORD		P	-	-	
		3. ISOLATION TEST BETWEEN(CORE TO CORE CLAMPS)	MA	TEST	100%	-			QC RECORD		P	-	-	
		4.TORQUE TIGHTNESS	MA	MEASURE	100%	-			QC RECORD		P	-	-	
		5. CORE INSULATION	MA	ELECTRICAL	100%	-			QC RECORD		P	-	-	
		6.CORE LOSS	MA	ELECTRICAL WITH DUMMY COIL	100%	100%			QC RECORD	✓	P	V	V	
		7. VISUAL CHECKS OF CORE VERTICALITY	MA	VISUAL	100%	-			QC RECORD		P	-	-	

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					M	C/N				D	M	C	N	
3.5	WINDING	1. BRAZING PROCEDURE & BRAZER QUALIFICATION	MA	REVIEW	100%	-	MANF. STANDARD	MANF. STANDARD	QC RECORD		P	-	-	
		2. CONDUCTOR SIZE.	MA	MEASUREMENT	100%	-			QC RECORD		P	-	-	
		3. REDIAL DEPTH OF WINDING	MA	MEASUREMENT	100%	-			QC RECORD		P	-	-	
		4. ANCHORING & BINDING AT START & FINISH	MA	MEASUREMENT	100%	-			QC RECORD		P	-	-	
		5. NO. OF TURNS	MA	MEASUREMENT	100%	-			QC RECORD		P	-	-	
		6. TRANSPOSITION OF CROSS-OVERS	MA	MEASUREMENT	100%	-			QC RECORD		P	-	-	
		7. DIMENSIONAL CHECK (0D,ID & AXIAL LENGTH)	MA	MEASUREMENT	100%	-			QC RECORD		P	-	-	
		8. INSULATION ARRANGEMENT & ALIGNMT.	MA	MEASUREMENT	100%	-			QC RECORD		P	-	-	
		9. WINDING LENGTH	MA	MEASUREMENT	100%	-			QC RECORD		P	-	-	
		10. BRAZED JOINTS	MA	MEASUREMENT	100%	-			QC RECORD		P	-	-	
		11. LEAD & COIL IDENTIFICATION AND MARKING	MA	MEASUREMENT	100%	-			QC RECORD		P	-	-	
		12.FREE FROM DAMAGES	MA	MEASUREMENT	100%	-			QC RECORD		P	-	-	
		13. CONTINUITY TEST FOR LEADS	MA	MEASUREMENT	100%				QC RECORD		P	-	-	
		14. TURN TO TURN INSULATION	MA	MEASUREMENT	100%	100%			QC RECORD	✓	P	V	V	
		15. MEASURE. OF RESISTANCE	MA	MEASUREMENT	100%	100%			QC RECORD	✓	P	V	V	
3.6	CORE COIL ASSEMBLY	1. CLEANLINESS OF CORE	MA	VISUAL	100%	-	MANF. STANDARD	MANF. STANDARD	QC RECORD		P	-	-	
		2. ALIGNMENT OF SPACERS/BLOCKS	MA	VISUAL	100%	-			QC RECORD		V	-	-	
		3. ELECT. CLEARANCE & INSP. OF CORE & COIL ASSLY AFTER COMPLETION OF TERMINAL GEAR	MA	VISUAL/MEASUREMENT	100%	-			QC RECORD		V	-	-	
		4. CHECK PROVISION OF CORE FRAME EARTHING	MA	VISUAL	100%	-			QC RECORD		V	-	-	
3.7	CONNECTION AND TAP SWITCH ASSEMBLY	1. RATIO TEST ON ALL TAPS	MA	TEST	100%	100%	MANF. STANDARD	MANF. STANDARD	QC RECORD	✓	P	V	V	
		2. LEAD DISPOSITION.	MA	VISUAL	100%	-			QC RECORD		P	-	-	
		3. BRAZING OF JOINTS	MA	VISUAL	100%	-			QC RECORD		P	-	-	
		4. CRIMPING OF JOINTS	MA	VISUAL	100%	-			QC RECORD		P	-	-	
		5. INSULATION OVER JOINTS	MA	VISUAL	100%	-			QC RECORD		P	-	-	
		6. VECTOR GROUP	MA	TEST	100%	-			QC RECORD		P	-	-	

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					M	C/N				D	M	C	N	
3.8	OVENING AND TANKING	1. CLEANLINESS OF TANK	MA	VISUAL	100%	-	MANF. DRG./RELEVANT STAND.	MANF. DRG./RELEVANT STAND.	QC RECORD		P	-	-	
		2. DRAWING	MA	PHYSICAL	100%	-			QC RECORD		P	-	-	
		3. CHECK TIGHTNESS OF CLAMPED BLOCKS AND MEASUREMENTS OF WINDING HEIGHT	MA	MEASUREMENT	100%	-			QC RECORD		P	-	-	
		4. ELECTRICAL CLEARANCES	MA	MEASUREMENT	100%	-			QC RECORD		P	-	-	
		5. OIL FILLING AND AIR RELEASE	MA	PHYSICAL	100%	-			QC RECORD		P	-	-	
		6. DRYNESS (TAN-DELTA & I.R)	MA	MEASUREMENT	100%	-			QC RECORD		P	-	-	
4	TYPE & SPECIAL TEST ON TRANSFORMER	1. REVIEW OF TYPE TEST & SPECIAL TEST REPORT	MA	VERIFY	100%	100%	REPORTS	REPORTS	TEST REPORTS	✓	P	V	V	1. Type test as per enclosed annexure-1 to be conducted. 2. BHEL SHALL WITNESS THE TESTS MENTIONED IN ANNEXURE-1. 3. CUSTOMER'S WITNESS SHALL BE INFORMED DURING DOCUMENT APPROVAL
		2.REVIEW OF ALL PREVIOUS STAGE OF INSP. AS PER QR PRIOR TO FINAL TESTING	MA	VERIFY					QC RECORD	✓	P	V	V	
5	ROUTINE TEST	1. VERIFICATION OF COMPLETENESS/ DIMENSIONAL CHECK	MA	MEASUREMENT	100%	100%	AS PER APPROVED OGA DATA SHEET/IS:2026	AS PER APPROVED OGA DATA SHEET/IS:2026	QC RECORD	✓	P	W	W	
		2. MEASUREMENT OF VOLTAGE RATIO AT ALL TAPS,POLARITY & VECTOR GROUP VERIFICATION	MA	MEASUREMENT	100%	100%	AS PER APPROVED DATA SHEET./IS2026	AS PER APPROVED DATA SHEET./IS2026	QC RECORD	✓	P	W	W	
		3. MEASUREMENT OF WINDING RESISTANCE ON HV & LV ON ALL THE TAPS	MA	MEASUREMENT	100%	100%	AS PER APPROVED DATA SHEET./IS2026	AS PER APPROVED DATA SHEET./IS2026	QC RECORD	✓	P	W	W	
		4. MAGNETIC BALANCE TEST	MA	MEASUREMENT	100%	100%	IS:2026	IS:2026	QC RECORD	✓	P	W	W	
		5. MEASUREMENT OF NO-LOAD LOSSES & CURRENT AT 90)%, 100% & 110% RATED VOLTAGE	MA	MEASUREMENT	100%	100%	AS PER APPROVED DATA SHEET./IS2026	AS PER APPROVED DATA SHEET./IS2026	QC RECORD	✓	P	W	W	
		6. LOAD LOSS & SHORT CIRCUIT IMPEDENCE MEASUREMENT ON PRINCIPAL & EXTREME TAPS.	MA	MEASUREMENT	100%	100%	AS PER APPROVED DATA SHEET./IS2026	AS PER APPROVED DATA SHEET./IS2026	QC RECORD	✓	P	W	W	
		7. DI-ELECTRIC TEST 1) INDUCED OVERVOLTAGE 2) SEPATATE SOURCE VOLTAGE WITHSTAND TEST	MA	MEASUREMENT	100%	100%	IS:2026	IS:2026	QC RECORD	✓	P	W	W	
		8. MEASUREMENTOF CAPACITANCE & TAN DELTA TO DETERMINE CAPACITANCE BETWEEN WINDING & EARTH	MA	MEASUREMENT	100%	100%	IS:2026	IS:2026	QC RECORD	✓	P	W	W	
		9. MEASUREMENT OF NO LOAD CURRENT WITH 415 V, 50 HZ AC SUPPLY.	MA	MEASUREMENT	100%	100%	AS PER APPROVED DATA SHEET./IS2026	AS PER APPROVED DATA SHEET./IS2026	QC RECORD	✓	P	W	W	

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					M	C/N				D	M	C	N	
		10. MEASUREMENT OF INSULATION RESISTANCE OF WINDING	MA	MEASUREMENT	100%	100%	IS:2026	IS:2026	QC RECORD	✓	P	W	W	
		11. REPEAT NO LOAD CURRENTS/LOSS MEASUREMENT & IR MEASUREMENT AFTER COMPLETION OF ALL DIELECTRIC TEST	MA	MEASUREMENT	100%	100%	AS PER APPROVED DATA SHEET./IS2026	AS PER APPROVED DATA SHEET./IS2026	QC RECORD	✓	P	W	W	
		12. VERIFICATION OF OIL LEAKAGE TEST WITH ALL FITTING & ACCESSORIES AT NORMAL PRESURE PLUS 35KPA FOR ~~24~~ 8 HOURS.	MA	MEASUREMENT	100%	100%	CBIP	CBIP	QC RECORD	✓	P	W	W	
		13. JACKING TEST FOLLOWED BY D.P. TEST	MA	MEASUREMENT	100%	100%	CBIP	CBIP	QC RECORD	✓	P	W	W	
		14. PAINT SHADE, ADHESSION TEST & DFT	MA	MEASUREMENT	RANDOM BASIS	RANDOM BASIS	DATA SHEET/ IS:101/ BHEL SPECIFICATION	DATA SHEET/ IS:101/ BHEL SPECIFICATION	QC RECORD	✓	P	W	W	
		15. PROTECTION ON M. BOX & CABLE BOX BY PAPER INSERTION	MA	MEASUREMENT	100%	100%	MFG. STD.	MFG. STD.	QC RECORD	✓	P	W	W	
		16. 2 KV TEST ON M.BOX WIRING & FUNCTIONAL CHECK FOR COMPONENT OF MB	MA	MEASUREMENT	100%	100%	APPROVED DWG./ MFG. STD.	APPROVED DWG./ MFG. STD.	QC RECORD	✓	P	W	W	
		17. MEASUREMENT OF ZERO SEQ. IMPEDANCE ON 3-PH UNIT	MA	MEASUREMENT	100%	100%	IS:2026	IS:2026	QC RECORD	✓	P	W	W	
		18. 2 KV CORE ISOLATION TEST	MA	MEASUREMENT	100%	100%	IS:2026	IS:2026	QC RECORD	✓	P	W	W	
		19. TEST ON TRANSFORMER OIL	MA	MEASUREMENT	RANDOM BASIS	RANDOM BASIS	IS: 335	IS: 335	QC RECORD	✓	P	W	W	
		20. FREQUENCY RESPONSE ANALYSIS TEST	MA	MEASUREMENT	100%	100%	AS PER APPROVED DATA SHEET./IS2026	AS PER APPROVED DATA SHEET./IS2026	QC RECORD	✓	P	W	W	This test shall also be undertaken by the manufacturer at site after transformer is installed. Same is covered in BOQ-Cum-Price Schedule
6	PRE SHIPMENT CHECK &DESPATCH	1. TRANSFORMER- VERIFICATION OF FINAL TRANSPORTION.	MA	VISUAL	100%	100%	BHEL SPECIFICATION	BHEL SPECIFICATION	QC RECORD	✓	P	W	W	
		2. DEW POINTS MEASUREMENT OF N2/DRY GAS TIGHTNESS/ PR READING (ONLY APPLICABLE FOR TRANSFORMERS DISPATCHED WITH GAS FILLING)	MA	MEASUREMENT	100%	100%	MANUF. STANDARD	MANUF. STANDARD	QC RECORD	✓	P	W	W	
		3. PACKING OF LOOSE ITEMS	MA	VISUAL	100%	100%	BHEL SPECIFICATION	BHEL SPECIFICATION	QC RECORD	✓	P	W	W	
7	Packing	Packing	MA	VISUAL	100%	100%	BHEL SPECIFICATION	BHEL SPECIFICATION		✓	P	W	W	REFER NOTE 9 & 10

NOTES:

1 BHEL RESERVES THE RIGHT FOR CONDUCTING REPEAT TEST IF REQUIRED.
2 IN CASE OF FOREIGN SUPPLIER, ALL TEST CERTIFICATES SHALL BE FURNISHED BY THE SUPPLIER, DULY WITNESSED/ VERIFIED BY SUPPLIER'S TPI.
3 PHOTOGRAPHS OF COMPLETE TRANSFORMER &ITS ACCESSORIES AFTER PACKING TO BE SENT TO BHEL PURCHASE GROUP FOR REVIEW BEFORE ISSUING MDCC.
4 IN CASE THERE ARE ANY CHANGES IN QP COMMENTED BY CUSTOMER AT CONTRACT STAGE, THE SAME SHALL BE CARRIED OUT BY THE BIDDER WITHOUT ANY IMPLICATION TO BHEL/ CUSTOMER.
5 PROJECT SPECIFIC QUALITY PLAN TO BE DEVELOPED BASED ON CUSTOMER REQUIREMENT.
~~6~~ ~~FOR EXPORT JOB, PACKING SHALL BE AS PER BHEL SEAWORTHY PACKING SPECIFICATION.~~
7 LATEST REVISION/ YEAR OF ISSUE OF ALL THE STANDARDS (IS/ ASME/ IEC ETC.) INDICATED IN QP SHALL BE REFERRED.
8 PACKING SHALL BE SUITABLE FOR STORAGE AT SITE IN TROPICAL CLIMATE CONDITIONS.
9 TRANSFORMER TANK SHALL BE DISPATCHED FILLED WITH OIL OR PURE DRY INERT NITROGEN GAS. IN CASE THE TANK IS FILLED WITH INERT GAS THE TEMPERATURE AND PRESSURE AT THE TIME OF GAS FILLING SHALL BE MARKED ON A TAG. A GRAPH SHOWING PRESSURE VS. TEMPERATURE SHALL BE ATTACHED FOR READING PRESSURES AT DIFFERENT TEMPERATURES.
10 IMPACT RECORDER/INDICATOR SHALL BE PROVIDED TO MONITOR THE IMPACT EXPERIENCED BY THE TRANSFORMER DURING TRANSPORT.

LEGENDS:

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		Nitish Manu	Checked by:		Kundan Prasad
Reviewed by:		Kanhaiya Kumar/Manish Shukla	Reviewed by:		Ritesh Kumar Jaiswal

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

ANNEXURE-1

Type TEST and Special Test to be conducted on 1 No. 10MVA, 11/3.45 Transformer.

SL. NO.	TYPE TEST	TO BE CONDUCTED IF APPLICABLE (Yes/No)	REMARKS
A	**Dielectric Type test (IEC60076-3) & Special Test**		
1.0	Dielectric test as per method 2 of IS 2026 part III	Yes	
2.0	Separate source voltage withstand test for 1 min HV-28kVrms, LV-10kVrms	Yes	
3.0	Full wave lightning impulse test on HV terminal at 75 kVp	Yes	
4.0	Full wave lightning impulse test on LV terminal at 40 kVp	Yes	
5.0	Switching impulse test on HV terminal at rated 75kVp	Yes	
6.0	Repeat no load loss and excitation current measurement after dielectric test at 100% rated voltage and rated frequency	Yes	
7.0	Determination of transient voltage transfer characteristic	Yes	
8.0	Measurement of transferred surge on LV winding due to HV lightning impulse	Yes	
B	Measurement of zero-sequence impedance of three-phase transformers	Yes	
C	Short circuit test	Yes	
D	Measurement of acoustic noise-level	Yes	
E	Measurement of the harmonics in the No-load current	Yes	
F	Vacuum withstand test (full vacuum)	Yes	
G	Degree of Protection Test on Cable Box	No	These Type test report(for all rating Transformer) in addition to other Type Test as per spec are to be submitted for review for test conducted within last 5 years as on 06/08/2018
H	Degree of Protection Test on Marshalling Box	No	
I	Temperature Rise Test Report	No	

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	TITLE :	SPECIFICATION NO.
BHEL	STANDARD TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	PE-SS-999-302-E001 VOLUME NO. : II SECTION : II REV NO. : 00 DATE : 30/06/2016 SHEET : 28 of 30

ANNEXURE - B

TRANSFORMER LOSSES

1. The No-Load and Load losses for transformers 2.0MVA & above and voltage ratio 33kV/6.9kV, 33kV/3.5kV, 11kV/6.9kV, 11kV/3.5kV, 6.6kV/3.5kV are given below:

Ratings	Maximum No-Load losses at rated frequency and 100%voltage	Maximum Load losses at normal ratio, rated current and 75 deg. C
10.0 MVA	9.0kW	72.0kW
8.0MVA	7.5 kW	57.0kW
7.5 MVA	7.2 kW	50.0kW
6.3MVA	6.5kW	45.0kW
5.0MVA	5.5kW	36.0kW
3.5MVA	4.5kW	32.0kW
2.5 MVA	2.8kW	30.0kW
2.0MVA	2.4 kW	24.0kW

The above indicated maximum No-Load and Load losses are inclusive of permissible tolerance as per IS-2026. Further tolerance on maximum losses is not permissible.

2. Transformers of rating 2.5MVA & below and voltage ratio 33kV/433V, 11kV/433V, 6.6kV/433V, 3.3kV/433V shall have Energy Efficiency Level 1 as per IS-1180. However, percent impedance shall be as per Data Sheet-A of section-I, volume-II of technical specification.

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	TITLE :	SPECIFICATION NO.
BHEL	**STANDARD TECHNICAL SPECIFICATION FOR**	**PE-SS-999-302-E001**
	OIL FILLED SERVICE TRANSFORMERS	VOLUME NO. : **II**
		SECTION : II
		REV NO. : **00** DATE : 30/06/2016
		SHEET : **29** of **30**

ANNEXURE – C

Terminal No.	Description	Remarks
T-01 T-02	230V, Single Phase, 50Hz, AC Supply	
T-03 T-04	MOG (Oil Level) Alarm	
T-05 T-06	Buchholz Relay Alarm	
T-07 Dummy T-08	Buchholz Relay Trip	
T-09 T-10	PRV-1 Alarm	If applicable
T-11 Dummy T-12	PRV-1 Trip	
T-13 T-14	PRV-2 Alarm	
T-15 Dummy T-16	PRV-2 Trip	
T-17 T-18	OTI Alarm	
T-19 Dummy T-20	OTI Trip	
T-21 T-22	WTI-1 Alarm	
T-23 Dummy T-24	WTI -1 Trip	
T-25 to T-28	SPARE	If applicable
T-29 T-30	4-20 mA for OTI (DDCMIS)	If applicable
T-31 T-32	4-20 mA for OTI (SCADA)	
T-33 T-34	4-20 mA for WTI-HV (DDCMIS)	
T-35 T-36	4-20 mA for WTI-HV (SCADA)	
T-37 to T-50	SPARE	
T-51 T-52	WTI 1-CT	If applicable
T-53	CT Shorting Terminal	
T-54 T-55	WTI 2-CT	
T-56	CT Shorting Terminal	
T-57 T-58	LV Neutral CT (REF Protection)	
T-59	CT Shorting Terminal	
T-60 T-61	LV Neutral CT (E/F Protection)	If applicable
T-62	CT Shorting Terminal	
T-63 T-64	HV Neutral CT (REF Protection)	
T-65	CT Shorting Terminal	
T-66 T-67	HV U-PHASE CT	
T-68	CT Shorting Terminal	
T-69 T-70	HV V-PHASE CT	
T-71	CT Shorting Terminal	
T-72 T-73	HV W-PHASE CT	
T-74	CT Shorting Terminal	
T-75 to T-80	SPARE TBs (for CT)	

Notes:

1). The Terminals from T-01 to T-48 shall be designated as indicated in the chart for all outdoor transformers (ONAN cooling).

2). The Terminals which are not used for a particular Transformer shall be left as spare. e.g. in case there is only one WTI alarm & trip, then terminals T-25 to T-28 & T-38 to T-40 shall be left as spare terminals.

3). Provide 20% spare TBs.

	TITLE :	SPECIFICATION NO.
BHEL	STANDARD TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	PE-SS-999-302-E001 VOLUME NO. : II SECTION : II REV NO. : 00 DATE : 30/06/2016 SHEET : 30 of 30

ANNEXURE – D

LIST OF O & M SPARES

S. NO.	DESCRIPTION	QTY
1	HV bushing with metal parts & gaskets	1 no. for each rating
2	LV bushing with metal parts & gaskets	1 no. for each rating
3	WTI with alarm & trip contacts	1 no.
4	OTI with alarm & trip contacts	1 no.
5	Magnetic oil level gauge	1 no.
6	Diaphragm of explosion vent	1 no.
7	Buchholz relay	1 no.
8	Silica gel charge	Three charge
9	Floats with contacts for Buchholz relay	1 set
10	Set of gaskets	2 sets
11	Set of valves (1 no. of each size & Type)	1 set
12	Set of windings for one limb in a suitable oil container (container shall be co mpletely filled with transformer oil)	1 no. of each rating & type of transformer.
13	Contact for tap changer	1 set
14	Pressure relief device for 2MVA & above transformers	1 no.
15 Hydraulic/	screw Jacks	4 no.
16	Any other item considered essential by the bidder	

Note:

1) Wherever set is indicated above, it means the total parts/ accessories required to replace the particular item for a given equipment

2) O & M spares shall be supplied along with transformers and packed separately with proper inscription.